POPULAR SCIENCE

MONTHLY 1872

JUNE · 1931

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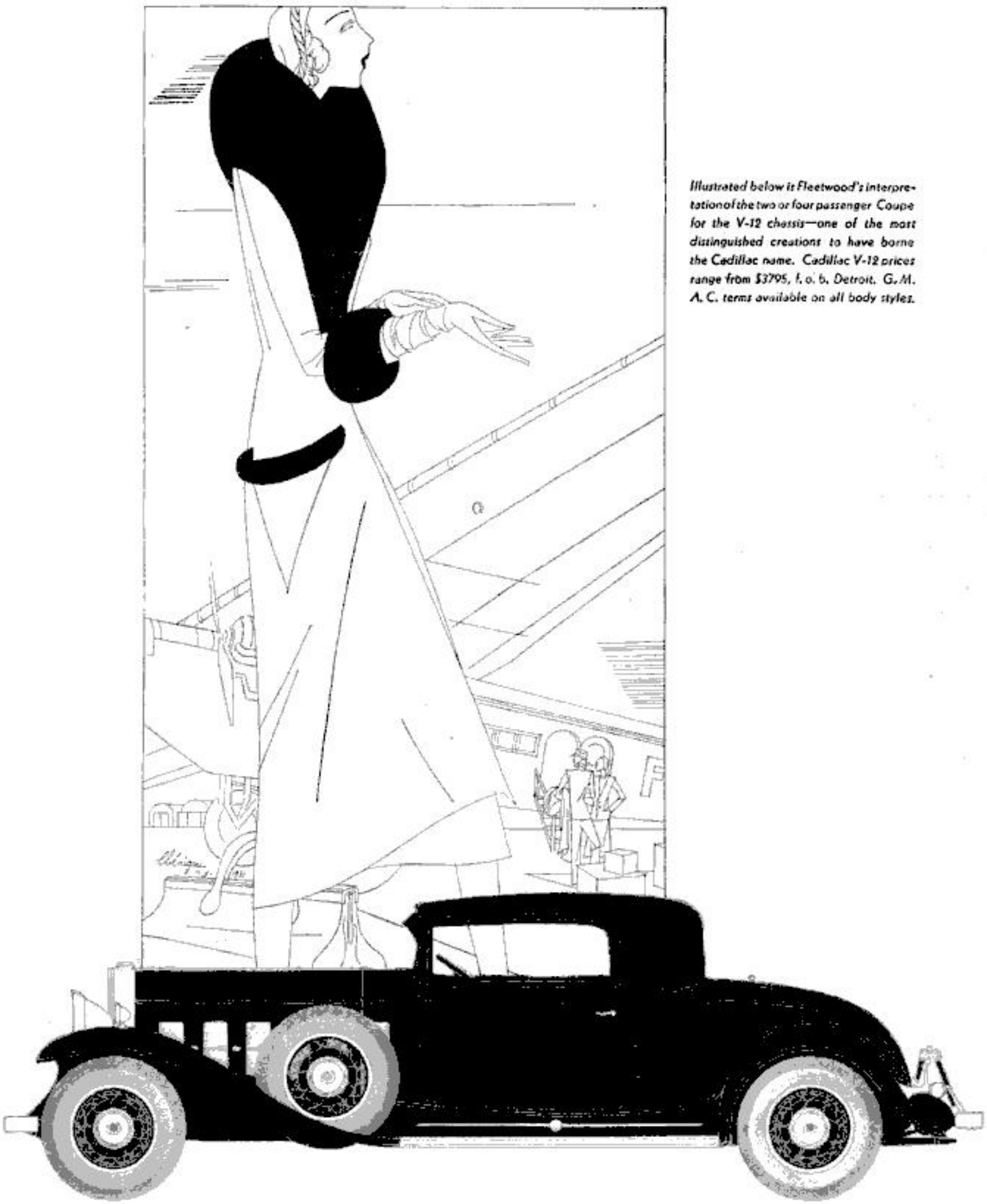

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POPULAR SCIENCE
MONTHLY

381 Fourth Avenue
New York, N. Y.

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June, 1931, Vol. 118, No. 6. **Popular Science Monthly** is published monthly at 381 Fourth Avenue, New York, N. Y., by the Popular Science Publishing Co., Inc. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Dayton, Ohio. Entered as second-class matter at the Post Office Department, Canada. Printed in U. S. A. Single copy, 25 cents. Nine months' subscription, $2. Yearly subscriptions to United States, its possessions, and Canada, $2.50; foreign countries, $3.

Popular Science Monthly for June, 1931

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FOR THE HOME OWNER

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IDEAS FOR THE HANDY MAN

HINTS FOR THE MECHANIC

12% GUARANTEED *for 20 Years* ON THIS INVESTMENT

By LEON MEADOW, *Financial Editor*

THE telephone on George Lambert's desk rang insistently. With a gesture of annoyance, he put aside the blueprint he was studying, and picked up the receiver. "Yes, Lambert speaking . . . oh, hello Steve, how's the boy? Glad to hear it, feeling pretty good myself. What's that—sell me more insurance? I should say not! I've got all I can do to support my own family without trying to keep your firm from going bankrupt—but I'll let you blow me to lunch, if that'll do you any good. Yes, make it today, and it will be a threesome as I have a date already, with my brother Dave. Meet us at the usual place, about twelve-fifteen . . . . right . . . goodbye."

After the three men had exchanged greetings and placed themselves at the table, Stephen Dorrance said, "I know you two will balk at my talking shop . . ."

"I certainly shall!" interrupted George Lambert. "Here we are at a little sociable lunch, and right off the bat you start on insurance. Is there no justice?"

"But all the same," continued Dorrance, as if no interruption had occurred, "there's a new form of policy being written by most of the large companies that is really worth listening to. Of course, if George is serious, I don't have to discuss it now."

"Nonsense, Steve," put in Dave Lambert, the elder of the two brothers. "I'm interested in what you have to say. I've always been fascinated by the possibilities of insurance as it's sold today. And, as for George, he's just nursing one of his occasional grouches. Big family man stuff, don't you know?"

George grinned good-naturedly. "All right, Dorrance," he said, "but make it short and don't try to sell me anything."

"Listen, boy—this policy is so good, it sells itself. As I said before, it has come into great favor recently and most of the large companies are writing it in one form or another. The general name given to it is 'Family Income Plan.' I'd like to make one point clear right now. This plan differs from other types of insurance in that it should not be considered strictly as insurance. You don't buy it—and we don't sell it—by the thousand dollar unit of insurance. I look upon it as an investment, unique in the investment field because of two things. First, because it takes into account, as do all insurance plans, and few so-called investments, the human element and the personal need. Second, because it is a means of providing a maximum income on the smallest amount of money."

"Very well," interrupted George, with a poor attempt at gruffness, "but let's have less speechmaking and more facts, Mr. Dorrance."

"A little patience, Mr. Lambert, and you'll get all the facts you want, before I'm finished. The Family Income Plan is an investment for men interested in providing a maximum income for dependents in the years in which they are most likely to need it. As I said before, the plan varies slightly, according to the company issuing it. Now I'm going to describe one plan in particular because I believe it to be best suited to the example I have in mind." Steve turned to George and smiled.

"Is it my turn now?" the latter asked. "Because, if it is, I just want you to know that I refuse to be taken for an example. It looks like an out-and-out frame-up to me!"

"Go ahead, Steve," joined in Dave Lambert. "If George makes a good example, you have my permission as an older brother to use him."

The three of them laughed, and Dorrance continued, "I won't use your name, George, if you'll let me have your circumstances. They're perfect for this case. Let's suppose that a certain Mr. X, like you, is married, thirty years old and also has a daughter of four and a little boy of two. In the next twenty years or so, his family needs will be at their maximum, because the children will not only be entirely dependent, but will also have to be educated, as well. If he should have the misfortune to die within that period, his family would need at least $200 a month on which to live. However, he has already made some investments, and knows as definitely as is humanly possible that he will be in a position to increase these holdings within the next five years or more. Figuring down to the last penny, he arrives at the conclusion that he still needs to create a principal that will bring in $100 a month, to make up the required $200. Calculating on a 5% yield, he would have to set up an investment of $24,000 more to do this. Under the circumstances that's impossible. So . . ."

"That's where you come in!" interrupted George.

"Exactly," replied Dorrance. "Under this plan I can sell him an investment yielding 12% a year, guaranteed for twenty years from the time he buys it, in event of his death during that twenty years."

"Twelve percent a year!" broke in Dave. "But that's abnormal; how is it done?"

"I haven't the time to explain that now, and there really isn't any need of doing it," replied Steve. "As long as it has the guarantee of a reputable insurance company, you needn't worry about it. Getting back to Mr. X: he has to make an investment of $10,000 to yield $100 a month, at 12%. But in this case, instead of actually laying out the $10,000, he buys that amount of life or endowment, or any other form of permanent insurance. In return for that, plus an extra yearly premium, his beneficiary gets the twenty year guaranteed income of $100 a month."

George Lambert looked up and said, "Of course, the hitch there lies in the extra premium."

"I was coming to that," replied Steve, "but first let me finish explaining the terms of the policy. In event of his death within twenty years after the policy is issued, his wife gets a monthly income of $100 for twenty years *from date of issue*. In addition, $10,000—or the face value of the policy—is returned in cash to the wife after the twenty years. If the insured lives after eighteen years, the extra premium is dropped at the nineteenth year and reverts to the straight rate for whatever form of insurance was taken out.

"Mr. X, at thirty, would pay for $10,000 Ordinary Life Insurance an average net premium per year, over the eighteen year period I just mentioned, of $166.30. Now, if this same Mr. X takes out the same amount of life insurance under The Family Income Plan in order to set up an income of $100 a month, then he pays an average yearly premium, over the same period, of $224.80—or an added cost of $58.50 per year."

"In other words," interrupted Dave, "if he lives, he pays about $1,200 extra over the eighteen years."

"That's right," replied Dorrance. "Now, let's see what he (Continued on page 6)

Quit Work at 55

THIS page tells how you can provide a life of leisure for yourself by following a simple financial program called the Retirement Income Plan.

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Retirement Income Plan

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"HOW TO GET THE THINGS YOU WANT."

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Business Address_____

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(Continued from page 4)

gets for that extra premium. Supposing he dies five years after taking out this policy. He has paid the company about $300 in extra premiums above the ordinary life rates. His wife receives $100 a month for fifteen years—or a total of $18,000. His two children are thus provided with funds for the best upbringing and education. At the end of those fifteen years, the wife receives $10,000 in cash or in the form of an annuity for life, if she so desires."

"That's all very well," began George, "but it still seems to me that the risk of losing that $1,200 extra premium charge is pretty strong."

"Maybe it is," answered Dorrance, "and maybe it isn't; that's purely a question of chance. But the fact remains that if you or any man is not willing to risk $5 a month to provide a wife and children with a larger amount of income than can possibly be secured elsewhere—then he has no right to even try to provide for them."

Dave, sensing the fact that Steve seemed rather excited about George's remark, turned to his brother and said, "Steve's talking sense, and you should be the first to realize it."

"I think I do, now," replied George, visibly subdued. "And I think I'd be more willing to risk that small amount, if I were surer of the return over the full twenty years. Why don't they issue a policy wherein the monthly payments are guaranteed for 20 years after death of the insured, rather than 20 years after date the policy was written? That would guarantee the income for the full period."

Dorrance sipped his coffee thoughtfully, and said, "They do. I was going to tell you about it later, and then draw a comparison between the two types. Since you've brought it up, let's settle it now.

"A policy such as you described certainly guarantees a larger return in cash than the one I outlined. At the same time it costs more to buy it. That brings up another angle to the whole thing. Remember that the purpose of this type of insurance is to return a maximum income at a minimum cost. If a man can afford as much insurance as he wants, I wouldn't advise him to buy either of these Family Income Policies. I would tell him to buy sufficient amount of ordinary life insurance, under a trust agreement—and get the same return permanently, rather than for twenty years. But for the men I'm talking about, for Dave and you and me, that amount is out of the question—so we must confine ourselves to getting the most out of what we can afford to pay.

"Getting back to the first point, insurance guaranteeing monthly income payments, over a full twenty years costs, roughly speaking, 10% more than the first type I described. Now, remember that the curve of income requirements for Mr. X's family is on a sharp upgrade while the children are being raised and educated. That is for approximately a twenty year period. After that, the curve descends rapidly because the children are then grown up, married or self-supporting. Soon the requirements are confined to the wife alone. The point is this: the man of limited means cannot afford to pay 10% more for an added income which is not an absolutely necessity. Whereas, by taking out the first plan, he saves that 10% and still insures his family of the same income, *in those years when it is most needed*. On the other hand, if he can afford that extra 10% in premiums, I should still advise him to stick to the first plan. By doing that he can put the 10% extra into more insurance and thus guarantee his family an even larger monthly income in the years when the curve is going up."

"I see your point—and it's well taken," admitted George.

"Likewise," put in his brother, "but, for a man in my circumstances, without children, wouldn't the second plan be more advisable?"

"Undoubtedly," replied Steve Dorrance, taking a small book out of his pocket. "Let me see . . . you're forty years old, aren't you?"

"Yes."

"Well, at your age, you can buy a guaranteed full twenty year income of $100 a month, under this second Family Income Plan, for $397.20—that's the average yearly premium for the twenty year period."

"And how much would the same amount of straight life insurance cost me?" Dave asked.

"Let's see . . . here it is . . . $226 for the average yearly premium during that same period. Roughly, that's a difference of $170. For that, in event of your death within twenty years after the policy is issued, the company guarantees your wife $100 a month for a full twenty years. That's a total of $24,000, and at the end of the twenty years the company will pay your wife $10,000 in cash, for a grand total of $34,000, plus extra dividends. In this case, that extra premium charge of $171.20 would buy you only $8,000 more straight life insurance—and would therefore only return you $18,000 in all. So, by risking at the maximum about $3,500 in extra premiums, you stand to gain the difference between $18,000 and $34,000—or $16,000.

"This policy," Dorrance continued, "has one advantage over the first income plan I discussed. Namely, the privilege of applying that extra premium charge toward the purchase of more permanent insurance at the end of each five years during the twenty years after issue of the policy. As the chance of outliving the twenty year period becomes more evident, you are thus enabled to reduce the amount you risk in extra premium charges by converting it into increased life insurance."

"Well," began Dave, "that certainly is an attractive feature, although, as you pointed out, the premiums of this policy run about 10% higher than they do on the first plan. And, in addition, you have to pay the extra premium for the full twenty years—as against eighteen years on the first. Still, I can readily appreciate the value of a policy like that for a man in my circumstances. Some night next week, run out to my house and we'll talk it over in detail. I don't mind saying I'm interested." David rose, reached for the check and paid it, over the protests of the other two.

When they got out on the street, George Lambert turned to Dorrance. "If you're not busy now, come up to the office and give me the complete story on the first plan we discussed. I'm more interested than you'd believe."

"Say, what's the big idea," Steve answered, with a smile. "Didn't you refuse point-blank to buy any more insurance? Suppose, now, I refuse to sell you any more?"

"Then the age of miracles has come," Lambert replied, as the two moved down the street.

To Help You Get Ahead

THE booklets listed below will help every family in laying out a financial plan. They will be sent on request.

"The Provident Provider" is a booklet describing a new savings plan which provides a regular retirement income for a man and insurance protection for his family. A copy will be mailed on request by Provident Mutual Life Insurance Company, Philadelphia, Pennsylvania.

The House Behind the Bonds reminds the investor of the importance, not only of studying the investment, but of checking up the banker who offers it. Address: Fidelity Bond & Mortgage Co., 1188 New York Life Building, Chicago, Ill.

How to Get the Things You Want tells how you can use insurance as an active part of your program for getting ahead financially. Phoenix Mutual Life Insurance Company, 328 Elm Street, Hartford, Conn., will send you this booklet on request.

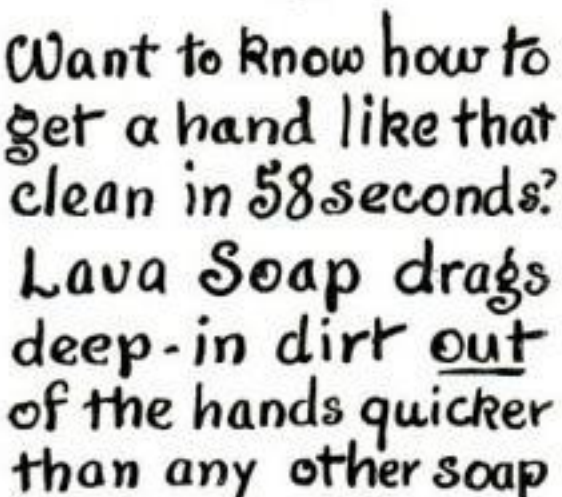
Enjoy Money shows how the regular investment of comparatively small sums under the Investors Syndicate plan, with annual compounding of 5½% interest, builds a permanent income producing estate, a financial reserve for a business, or a fund for university education or foreign travel. Write for this booklet to Investors Syndicate, Investors Syndicate Building, Minneapolis, Minnesota.

How to Retire in Fifteen Years is the story of a safe, sure and definite method of establishing an estate and building an independent income which will support you the rest of your life on the basis of your present living budget. Write for the booklet to Cochran & McCluer Company, 46 North Dearborn St., Chicago, Ill.

See How Easy It Is tells how it is possible to start off with a definite plan for creating an immediate estate leading to future financial security. Get your copy of this booklet by writing to Postal Life Insurance Company, 511 Fifth Avenue, New York City.

Want to know how to get a hand like that clean in 58 seconds? Lava Soap drags deep-in dirt out of the hands quicker than any other soap in the world — without hurting the skin.

George, the Lava Soap Man



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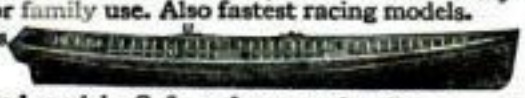

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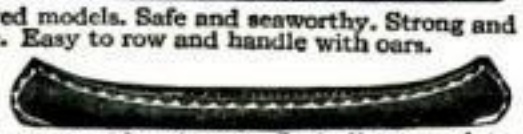

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Tools, Radio Apparatus, Oil Burners and Refrigerators advertised in POPULAR SCIENCE MONTHLY have been tested or investigated by the Popular Science Institute of Standards and each advertisement carries the insignia indicating approval.

However, other products advertised in the magazine not subject to test carry the same guarantee to readers as products tested.

THE PUBLISHERS

WHEN A BEARING GOES TO SEA

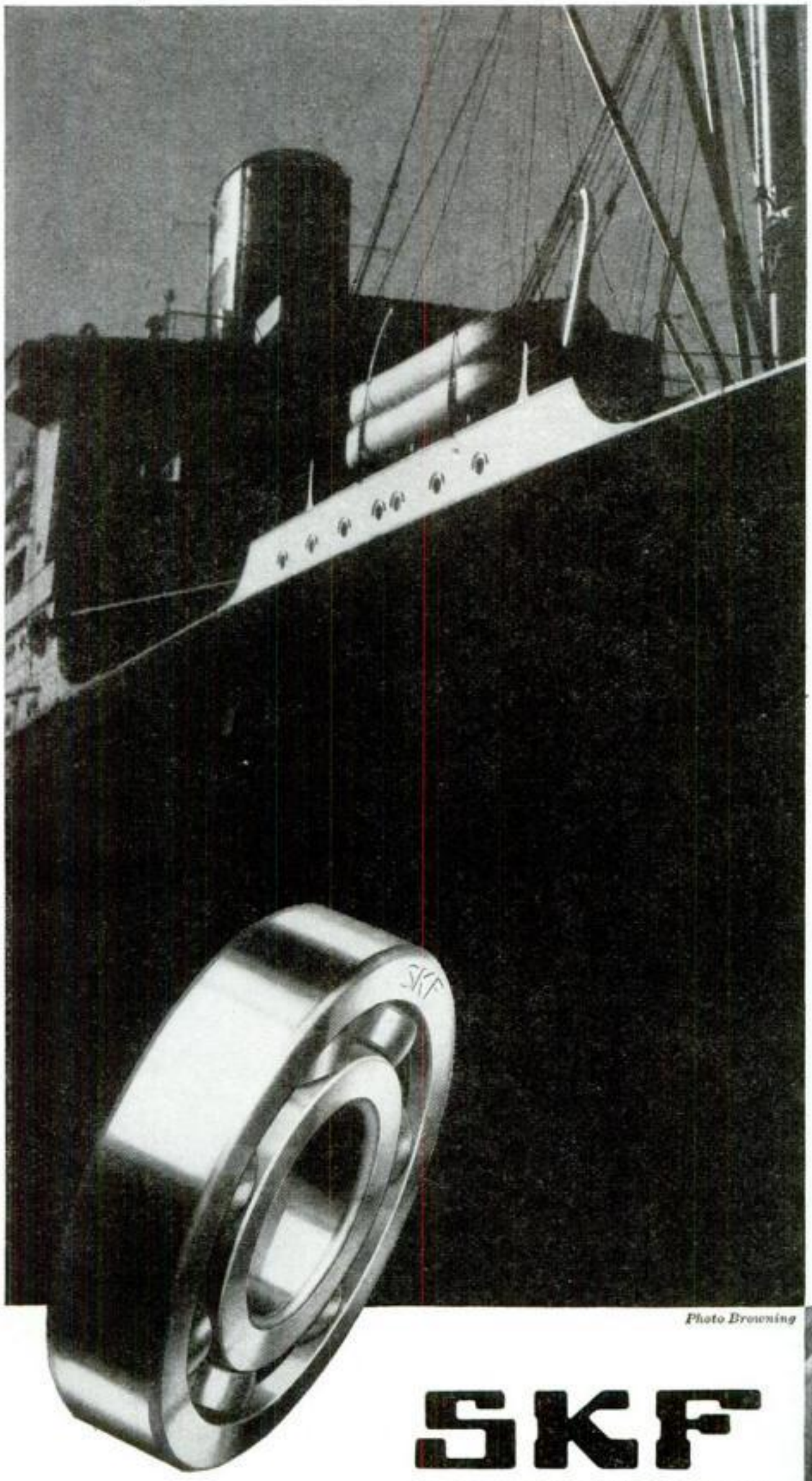

Photo Browning

...there's nothing but PERFORMANCE that counts

HERE'S to a hail and hearty deep-water bearing that goes sailing over the Seven Seas and gets a nod of approval from salty engineers in every port on the globe. You know the bearing, too. It's **SKF**.

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SKF

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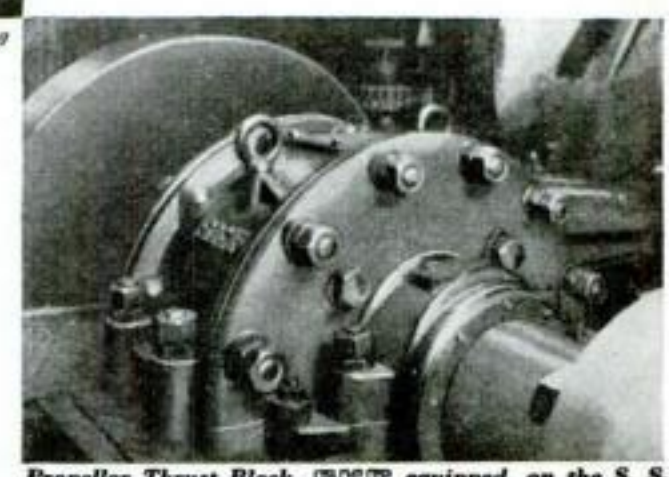
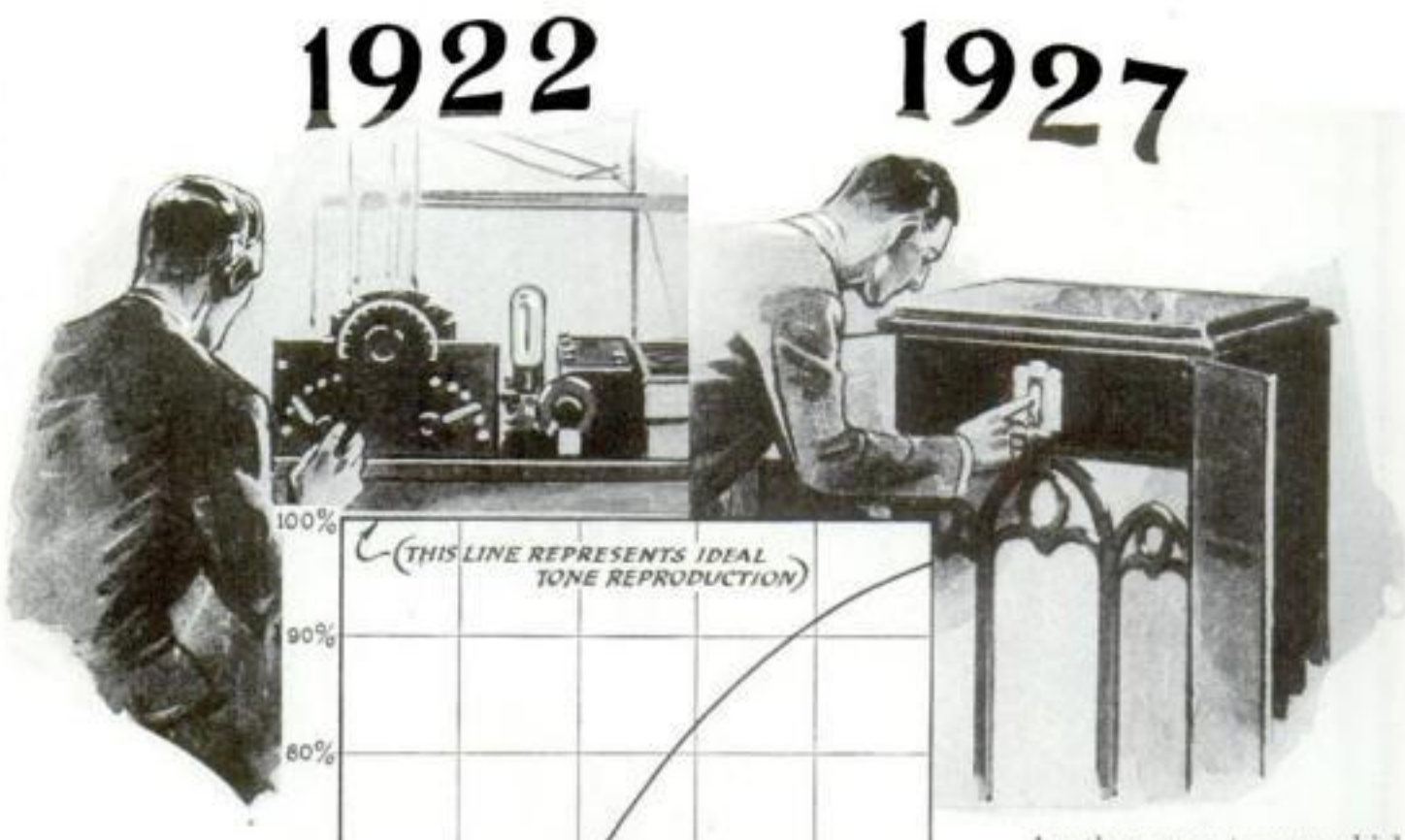


Propellor Thrust Block, SKF equipped, on the S. S. "Robur 4th." SKF Bearings are also used on auxiliary equipment of the S. S. "Leviathan" as well as on many other trans-Atlantic liners.

2670

Should I Buy a New Radio Now?

Present sets approach perfection so closely that those bought now will not be outmoded by any changes that are likely to be made in the next few years.



This chart shows how radio sets have improved in tone reproduction.

By F. G. PRYOR
Sec., Popular Science Institute

A GOOD modern receiver would double and triple the radio enjoyment of many people who are struggling along with an old radio outfit. The new set, in many cases, would not cost as much as the old.

But it is not so much money consideration that is keeping these people from replacing their out-of-date sets as one mistaken idea or another—all of which could be quickly exploded were they given the chance to talk to a radio expert. Most of the reasons advanced against radio investments at this time seem foolish to radio engineers who know the facts about current receivers and their place in the radio future.

Probably the thing that is holding most people back from buying a new radio set is the belief that great changes and improvements are imminent, and that if they wait a while longer they will get a far superior outfit at lower cost. This is an erroneous idea in the opinion of the radio engineers on POPULAR SCIENCE INSTITUTE's staff, who believe that radio development has reached the "coasting" point.

This belief is based principally on the fact that radio has already reached a point close to perfection, and the chances of greatly exceeding the present degree of excellence are therefore slight. For instance, in the matter of fidelity of reproduction, the chart shown above illustrates how very close some of the recent sets approach ideal tone—ninety-six percent.

The calculations upon which this chart is based include only tests on the full-sized standard set of each manufacturer. When it is noted from this chart how far from perfection was the popular receiver of 1927 and how near the ideal are late models, it becomes evident what great strides have been made in the past three or four years and how little is left to be accomplished. While the chart shows the improvement that has taken place in tone reproduction, similar headway has been made in selectivity and sensitivity, efficient present day sets having these essential features developed to a high degree.

SUCH progress as there may be in radio is likely to come very slowly and to lie in the direction of improved engineering rather than improved reception. That is, the development of new and more powerful tubes will probably permit more simple design and make it possible to achieve more easily results that are obtained today through more complicated construction. But such manufacturing changes matter little to the radio buyer and it can be said that, from present indications, the good radio set purchased today should continue to give results comparable with the best that radio will have to offer for a number of years.

Another aspect over which some prospective buyers are concerned is the matter of short-wave broadcasting. On this score, they question the future usefulness of present radio receiving sets, believing that the short-wave type of set will come to be used entirely in the near future.

But it is unlikely that short-wave broadcasting ever will be used to any extent for radio entertainment. The chief basis for this statement is the fact that short-wave broadcasting skips a certain area. The radio receiver at a great distance will pick up the signals of a short-wave station, while sets in the immediate vicinity and intervening area will not be able to receive any of its signals.

THEN, television is one more obstacle in the minds of other people who would like a new radio set but for the possibility that it might be made obsolete soon by combination radio-television equipment. Regardless of when television for home entertainment does come, it certainly will not affect one's investment in a radio receiver for broadcast reception—for reasons to be explained in a special article next month.

As to the matter of cost, radio engineers on the Institute staff do not look for much variation in the present price scale either for the coming season or succeeding years. Plans in the industry for 1931-32 indicate that there will be three price levels: (1) Midget sets with more elaborate cabinets than this season selling at $65 to $70; (2) Full-sized receivers at $90 average level; and (3) Finer sets selling from $110 up to $300.

There is no reason, either from the standpoint of price or performance, why anyone who needs a new set should put off buying it. If it is a question of not being able to determine whether in a particular case great improvement would be noticed in buying a new set, readers are at liberty to put their problem up to POPULAR SCIENCE INSTITUTE.

State the make and model receiver being used, when it was bought, and how much was paid. Also advise how much could be spent on a new set at the present time and what feature is of greatest importance (tone, selectivity, distance, cabinet). If the above facts are supplied and accompanied with stamped return envelope, we will endeavor to tell you what to do.

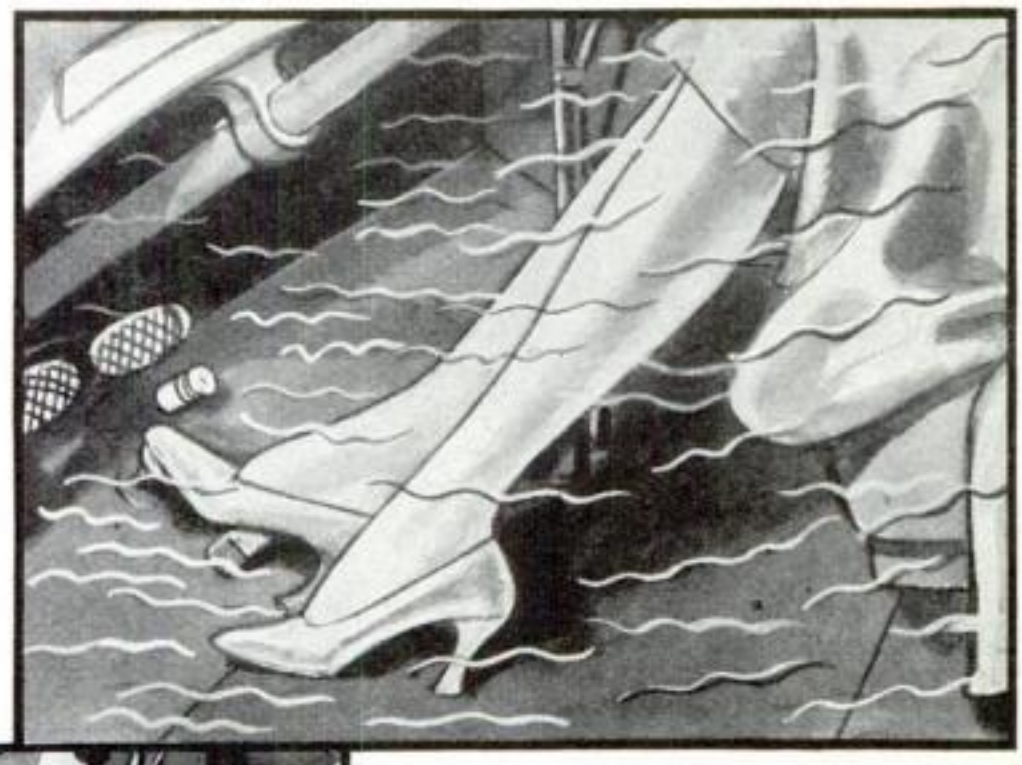
This offer applies only to owners of sets brought out since 1927 which are nationally known and with which we would have had testing experience. Address POPULAR SCIENCE INSTITUTE, 381 Fourth Ave., New York, N. Y.

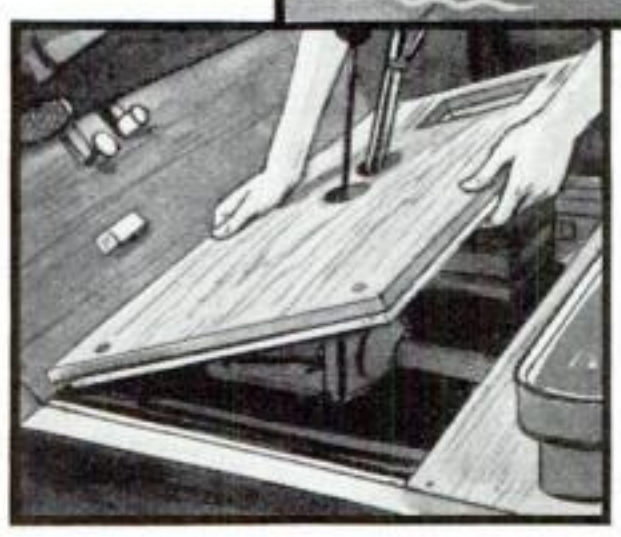
PREPARE FOR HOT WEATHER

FREE PLANS

THAT SHOW YOU HOW TO INSULATE YOUR CAR AGAINST MOTOR HEAT WITH

INSULITE
the Wood-Fiber Insulating Board





MOTOR heat through the floor of your car on a hot day makes summer driving unpleasant. It's easy to stop this heat—all you need is about 75¢ worth of Insulite. You can get it from your lumber dealer. The Insulite Engineering Department has prepared plans and instructions that show you how to insulate the floor and dash of your car, and they will send these plans and full instructions to you without cost.

You know the high insulating value of Insulite. It has been used for years for the protection of homes against unfriendly weather. Insulite is a full 1/2 inch thick insulating board, which means 12 1/2% more insulation than you get in ordinary 7/16 inch insulating boards. It is made from the strong tough fibers of northern woods, is chemically treated to resist moisture, and is not subject to rot or disintegration. Used as sheathing, Insulite adds bracing strength to your home; and as a base for plaster, it grips with much greater strength than wood lath, eliminates lath marks, and guards against unsightly plaster cracks. In summer, Insulite forms a barrier to the sweltering rays of the sun and makes your home cool and comfortable on the hottest days. In winter, Insulite keeps the cold out, reduces furnace heat loss, makes your home easier to heat, and pays dividends in fuel savings through all the years.

The fact that a large percentage of the well known refrigerator manufacturers insulate their cabinets with Insulite is evidence of its high thermal efficiency.

Hot summer days will soon be here. Now is the time to insulate your car with Insulite. Anyone handy with a hammer and saw can follow the simple instructions which will make your summer driving a pleasure. Then when you build or remodel your home, it will not be necessary to prove to you the superior insulating efficiency of Insulite—you'll know and specify it for your home.

FREE PLANS . . . FREE BOOK

With these free plans for insulating your car, we will also send you a copy of our free booklet—"Increasing Home Enjoyment". It's chock-full of clever ideas for transforming waste attic or basement space into useful and attractive rooms.

Just FILL OUT and MAIL COUPON

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(A Backus-Brooks Industry)
1200 Builders Exchange, Dept. 43F
Minneapolis, Minnesota
OFFICES IN ALL PRINCIPAL CITIES

Please send me a sample of Insulite and free plans and instructions for insulating my car against motor heat. Send me also a copy of your booklet—"Increasing Home Enjoyment".

Name.....
Address.....
City..... State.....

For Efficiency and Economy be sure the refrigerator you select is insulated with INSULITE

INSULITE
the Wood-Fiber Insulating Board

Our Readers Say

His Boiling Point Isn't Low, Either

When I read the letter from Goshen, Ind., in a recent issue of Popular Science Monthly, I sure started to boil. The very idea of anyone saying such a thing about Popular Science Monthly is enough to make me bite a ten-penny nail in two. When O. O. wrote that letter he must have been under some malign influence. I say that Popular Science Monthly is the best magazine published and if Mr. O. O. can show me a magazine with more science in it, I will take it along with your magazine, but I will *never* stop taking Popular Science Monthly as long as I live.—C. E. B., Spring Valley, Ohio.

Is It a Subterfuge or a Real Answer?

In the ditch problem presented by S. J. T. the problem is easier to solve if we take into account the factor of time. As there is one foot of hard digging for each foot of easy digging then there will be fifty feet of each kind. If each man earns seventy-five cents an hour at the end of one hour John will dig one foot and Bill will dig three fifths of a foot. In fifty hours of digging John will finish the easy end and Bill will dig thirty feet of the hard end. Each man now digs ten feet of hard digging so at the end Bill digs forty feet of hard ditch and John digs ten feet of hard ditch and fifty feet of soft ditch. At the price of $1.25 for hard and seventy-five cents for soft ditch each man will receive $50 and will have worked the same number of hours.—E. J. P., Plainfield, Conn.

Here's an Attractive Problem for You

Here is a new one for your readers to figure out, if any are able to do so. Suppose you had a magnet and directly underneath this magnet was a needle. Suppose that the needle was held down by a thread in the middle, so that it could be lifted up by the magnet, but would still be restrained by the thread. Now hold your magnet just above the length of the thread, so that the magnet is supporting the needle, but still not touching it. Will the magnet weigh any more while it is supporting the needle? The magnet is not touching the needle, but still it is supporting it and the thread. I shall be very glad to have any of your readers figure this out for me and let me know in the columns of "Our Readers Say" just what the answer is.—B. McC., Fort Madison, Iowa.

That Coiled Spring Turns into Heat

Replying to G. M., Martinez, Calif., who asked a question with reference to a coiled spring consumed in acid, I would say that while the acid is destroying the spring, the potential energy in the spring will change into heat energy which will appear in the form of raised temperature in the acid.—L. C. R., New York, N. Y.

We Seem to Have Started a Debate

Permit me to thank you for the articles on Russia. You have been content to state clearly and dispassionately the salient facts of one of the world's greatest idealistic endeavors and whether it succeeds or fails, it will do so irrespective of all the fantastic lying which American journals have stooped to. Your article is an oasis of fairness amidst so much that is produced by men more concerned in advancing their own beliefs than the honest presentation of facts which are ascertainable.—C. D. B., Deep River, Conn.

I was so unfortunate as to read your articles on Russia. What are you trying to do—start Soviets in America? And do you mind telling me why you publish such stuff, and under just what head, please, do you classify it as science? I don't think I'm being unduly bigoted when I assume that there are real scientific problems and achievements in this country that deserve your attention. I for one have no interest in red-eyed Russia and her mad maunderings nor in your endeavors to spread her propaganda. My best advice to you is to ignore Russia. I surmise that it is along that line that your prosperity lies.—F. P. S., Denver, Colo.

Battleship Model Wanted, Please

Let me second the motion of J. A. G., Ottawa, Canada, for a model of the *Bremen* or *Europa*. This would be fine. But I would rather have a model of a U. S. battleship, such as the *Colorado* or *California*. Can't we persuade Capt. McCann to design such a model for us?—R. F. McG., Winnetka, Ill.

Just a Simple Saw and an Old, Old Law

The trouble with F. H. L. as to how a saw cuts is that he forgets the board is advancing against his band saw. The resultant of its motion and that of the saw is a diagonal, not a perpendicular, cut by each particular tooth, the depth depending on the sharpness of the saw and the rapidity with which the board is fed to it. Wherefore, each tooth of the saw has its own cut to make and does not follow in the path of the preceding one.—O. H. G., Franklin, Pa.

Looking for Other Worlds to Conquer

Some time ago a certain scientific authority stated that flying through cosmic space was now at the same stage that aviation had reached thirty-six years ago. I wonder if this time could not be reduced? All the necessities for cosmic navigation are at hand and we need only a successful combination of them. The chief obstacle to successful space flight was once the velocity necessary to be maintained. We now have the rocket which can provide the required speed of seven and a half miles a second. We also have the nitroglycerin and other explosives and other forms of rocket fuel that have recently been developed. Another difficulty lay in the friction resulting from so high a speed. But this could be overcome by using an airplane speed until rarefied air was reached. The results of space flying would be most beneficial to the human race. The moons of Jupiter may offer livable conditions as may also Venus. By decomposing certain minerals it may be possible to create an atmosphere on the moon and thereby make it habitable, which certainly would be a desirable extension of territory for the progressive and conquering nation.—K. G., Sleepy Eye, Minn.

Are Tall Buildings Stopping the Earth?

Here is an idea the wisdom of which I am not certain, but I should like to know what the readers of your magazine think of it: What will those tall buildings, as for example the Empire State Building, do to the movement of the earth? My idea is that they are slowing up the rotation of the earth. A light weight attached to one side of a freely revolving sphere will tend gradually to stop the sphere and eventually it will cease to move with the side to which the weight is attached pointed toward the earth. In the same way I believe the high buildings will cause the earth to stop rotating. Indeed, I think there is already a noticeable difference as there has been a distinct change in climate in the latitude of New York City since 1898, which

NOBODY PAID ME $1000

"I GUESS you'd call this a testimonial all right, but nobody paid me a thousand dollars for it like they do those society women. I'll be lucky if I get an extra bone. After all, it's only a story about my love for the boss, and I don't suppose it's worth much.

"I was just a puppy in a kennel when the boss came and took me away. It was pretty hard leaving my mother, but when I saw the boss' plain, kind face and felt his big, gentle hands, I knew that he and I were going to get along.

"Well, life was simply wonderful. All day long there were cats to chase. Any number of them. I don't think anything's more fun than putting the fear of death into a fat, complacent cat. They say, of course, that it can be overdone, but I doubt it.

"Every night when the boss would come home we'd romp down to the sea and he'd talk to me. Once or twice he let me take a snap at that nasty Chow across the street. A swell guy. And on week-ends we'd go out in his boat with some of his cronies. At night they'd sit around the cabin light and talk about the places they'd been, places they'd like to be, and yachts they'd sailed, and how some day they'd buy a big schooner and go off to the South Sea Islands and grow old in a fig leaf.

"'A beautiful hand-painted chance you'll have of getting to the South Seas,' laughed one of the boss' friends, 'with the market the way it is, and Elizabeth Carstairs waiting next door. Why, Charlie, my boy, within another six months you'll be doing the lock-step up the dark halls of matrimony. You'll be home thumbing seed catalogues under the eagle eye of the adored one, while stout fellows like myself are braving the raging main.'

"'She's a wonderful girl!' answered the boss. 'You are simply envious.'

"I guess she was a wonderful girl all right. And beautiful, too, with that kind of reserved, stately beauty you see in Massachusetts women. The boss adored her. I can't say as much for myself. I would have liked to yap at her heels. She seemed kind of shallow to me—always fussing about little things.

"Suddenly she began to act sort of distant to the boss. They didn't kiss as often as they used to. He seemed to annoy her, although he was just as sweet as he could be to her. Naturally, this cold attitude of hers bothered him; he used to sit with his head in his hands wondering what was wrong.

"And at first I didn't have the slightest inkling myself. But later I knew what the trouble was. Or at least I thought I did. After all, a dog's keenest sense is that of smell, and there could be no doubt that the boss' breath wasn't beyond reproach.

"I am only a dog, but I know that a man can't get away with a thing like that. The ads say that even a man's best friend won't tell him, but, believe me, the only reason I didn't tell him was because *I couldn't*. I tried hard enough. But whimpers and barks don't convey much.

"It wasn't long after that that she broke the engagement—and his heart, too, I guess. He never went anywhere—not even to his boat. Just moped.

"Then one night he got wise. I like to think I helped him see himself as others—including Miss Carstairs—saw him. It happened this way:

"There was a magazine lying open on the floor where it had fallen from the rack. Face up was one of those Listerine ads. Well, sir, I just went up and put my paw on it and barked till I was hoarse.

"'For the love of Christmas, keep quiet,' he exclaimed, 'and get off that magazine.'

"Then he picked it up!

"Something made him read it. He read it all the way through.

"He must have taken the hint because he and Miss Carstairs have patched it up. The wedding's next month. And now, if you'll excuse me, there's a little cat trouble outside I'll have to attend to."

Halitosis (unpleasant breath) is the unforgivable fault in social and business life. Every day, conditions capable of causing it may arise in even normal mouths.

The one way to put yourself on the safe, polite, and acceptable side is to rinse the mouth with full strength Listerine. Every morning. Every night. And between times before meeting others. Listerine strikes at the cause of odors (fermentation and infection of the mouth, nose, and throat) and destroys the odors themselves. Lambert Pharmacal Company, St. Louis, Mo., U. S. A.

may be due to a decrease in the rate of revolution. I shall be glad to know what the other readers of this page think of this theory.—W. F. G., Corona, L. I., N. Y.

Believe It or Not, There's No Lost Day

IN A RECENT issue of your magazine you state that the earth revolves 366 times and we have only 365 days. "What becomes of the extra day?" you ask. There is no extra revolution and no extra day. Every time the earth makes a complete turn we have a day and a night. Roll a ball around a circle in the center of which is a light and you will find that every time a marked place on the ball returns to the rim of the circle it has made one revolution and traveled the distance equal to its circumference. Every time the mark is straight in line with the center of the circle it is noon or midnight. There is a straight line from the outside of the ball through the ball and on to the center of the circle, so it is impossible for the ball to revolve without causing day and night. In your article you give to the earth's orbit something it hasn't, as north, south, etc., and you suppose that the mark on the ball must return to the north or starting point, and that it must point to it before a revolution can be called complete. This is false. Of course figuring this way, which is wrong, there would be an extra turn. This is not the first time I have heard the "day lost" problem, but what I want you to get is that when revolving motion is given to the ball, there is no extra turn and no lost day. And this, I think you will admit, is in reality the exact condition that exists with reference to the daily and annual revolutions of our earth. Hence your statements are misleading. —D. G., Hale Center, Texas.

It's Just Vibration, Not Power of Mind

IN ANSWER to E. S. Q., Annapolis, Md., who asked a question about a notched stick and a moving propeller, I admit that I also have been puzzled by it. Some people say it is static electricity, a positive mind, or some other foolishness of that sort. But I've found out that it is merely vibration. This can be proved by holding the notched stick firmly on the edge of a table and then rubbing the notches. In that case nothing happens to the propeller.—R. N. F., Monmouth, Ill.

What the Well-Dressed Man Will Wear

DURING last summer's hot spell, a few men throughout the country ignored the conventional men's dress styles and adopted pajamas for street wear. This must have been an indication that some men were in favor of dress reform and at the same time were willing to lead the way themselves. I think that the movement would gain popularity if we could agree on one general style for summer wear. I suggest linen knickers, lightweight socks, a light-colored, low neck shirt, a tie being optional, and no coat. What do other readers think? —H. B. H., Philadelphia, Pa.

Keep Your Eye on the Plane—Don't Get Dizzy

I WISH some of your accomplished mathematicians would try the following problem on their accordions and let me know, in "Readers Say," what the result is: If one is standing on a plain and sees an airplane come from below the horizon four miles in front of him, and if in three minutes it passes over his head at an elevation of 2,000 feet, and if four minutes later it disappears beyond the opposite horizon, how far did the airplane travel and how fast was it going?—H. D. B., Fort Johnson, N. Y.

We Can Make Our Own Metric System

IT IS no wonder that the advocates of the metric system find our English system of measures an anomaly in this age of standardization. But our very standardization makes it impossible to adopt the system advocated. We can not *adopt* the metric system but we can *adapt* it.

It is not the meter that is rational and the inch that is irrational; it is the relation of these measures to their respective systems that is rational in the one case and absurd in the other. To build a convenient decimal system of English measures, all that is needed is to use a twenty-five-inch stick as the correlative of the meter and do everything with it that has been done with the meter. Such a stick would be divided into ten and one hundred equal parts appropriately named. The latter unit would be one quarter of an inch and hence would fit in readily with our machinery. Let us call this twenty-five-inch measure a "Stik." A one and one half inch pipe would then be called a six-centistik pipe. A kilostik would be .394 miles, or in ordinary usage we might say that five kilostiks were equal to two miles. The acre would be replaced by a square measure that, incidentally, is of almost the same area, but has a hectastik for its side. Such a change would shorten much schoolwork and eliminate many laborious calculations and the errors that go with them. Perhaps most important of all is the fact that the measures of practical life would meet the requirement of science and thus tend to bring together science and industry.—F. W. T., Duluth, Minn.

Finding Cow's Rope Is Laborious Process

IN RE that silly cow that is tied to a post on the circumference of a circular field 100 feet in diameter and who wants to know how long a rope she must have in order to graze over half the area of the field: The problem can be solved by the trial method with the use of plane geometry and plane trigonometry. Using this method I found the length of the rope to be fifty-eight plus feet.—T. B. K., Rochester, N. Y.

New Mixing Sticks Prove to Be Old

I NOTICED in a recent issue of POPULAR SCIENCE MONTHLY an illustration of aluminum mixing sticks. Two or three years ago while traveling in Africa I found the natives in the Kraals using a stick with two prongs for the mixing of their cornmeal mush, and I purchased one of these at a camp in Central Africa. It is used the same as described in your magazine. You might be interested in noting this rather crude device which has been used for years among these native black people of Africa, thus again proving there is nothing new under the sun.—R. O. B., Toledo, Ohio.

According to Him It's a Vicious Circle

MR. MOK in his article on unemployment suggests that the present economic distress is the result of an overproduction of raw material. Yet our census report shows us that each year there are fewer people engaged in producing these raw materials and each year the overproduction becomes more apparent. Can it be that the machine age in agriculture is not responsible for this? The United States led the world in the mechanization of the farm, and for a while we got by with it because there was a world shortage of food. However, as production was speeded up with better machinery our manufacturers had to seek world markets and soon foreign countries were producing more than enough food. During this time farmers, clerks, and laborers bought and bought until their cash was gone, until their credit was gone, and then, zowie! everything went flat. Now if production speeds are lowered to meet the annual demands, the result is men out of work; if speed is maintained, it means men out of work. I have no fight with machines. I have them and I wouldn't do without them. But don't we kid ourselves when we try not to face the fact that we are always going to have a great percentage of our people out of work? I hope you can prove that I am all wrong. It's a glorious age when everything clicks—but I can't see how we are going to keep it clicking.—R. C. W., Beulah, Mich.

It Would Be Hard to Find a Better Reason

I AGREE with H. P. of Black Eddy, Pa., in that I do not like the babblings of these so-called scientists. Their wild guessing is laughable. And that's why I read POPULAR SCIENCE MONTHLY.—D. J. S., San Francisco, Calif.

Just to Keep Autogiros in Their Place

WRITING in POPULAR SCIENCE MONTHLY of autogiros, Mr. Jordanoff says: "In the air the windmill is never operated by the engine. The vanes are turned by the air rushing past them." I understand that the standard propeller pulls the plane ahead, giving a great velocity to the air rushing past the windmill vanes. The autogiro has four vanes. Assuming that two of the vanes are, momentarily, right and left of the flying axis, the others will be in direct line with the flying axis. This means that the forces are counterbalancing each other. Of course I know that the lifting power of the revolving blades depends largely upon the number of revolutions, and this in turn is dependent upon the horizontal speed of the plane. This speed relation and the necessity to operate the windmill by the motor when flying at low speed, ought to be pointed out distinctly.—Mr. Z., Detroit, Mich.

Statement of Ownership, Management, Circulation, etc., required by the Act of Congress of August 24, 1912, of Popular Science Monthly, published monthly at New York, N. Y., for October 1, 1930, State of New York, County of New York, ss. Before me, a notary public in and for the State and county aforesaid, personally appeared A. L. Cole, who, having been duly sworn according to law, deposes and says that he is the Business Manager of Popular Science Monthly and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforsaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in Section 411, Postal Laws and Regulations, printed on the reverse of this form to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are Publisher, Popular Science Publishing Co., Inc., 381 Fourth Avenue, New York, N. Y., Editor, Raymond J. Brown, 381 Fourth Avenue, New York, N. Y., Managing Editor, Raymond J. Brown, 381 Fourth Ave., New York, N. Y., Business Manager, A. L. Cole, 381 Fourth Avenue, New York, N. Y. 2. That the owners are: Popular Science Publishing Company, Inc., 381 Fourth Avenue, New York, N. Y.; Stockholders of Popular Science Publishing Company, Inc., Henry J. Fisher, 230 Park Ave., New York, N. Y.; Oliver B. Capen, 381 Fourth Avenue, New York, N. Y.; Robert Cade Wilson, 683 Springfield Avenue, Summit, N. J.; Ada B. Wilson, 683 Springfield Avenue, Summit, N. J.; A. L. Cole, 381 Fourth Avenue, New York, N. Y.; John Nichols, 381 Fourth Avenue, New York, N. Y. 3. That the known bondholders, mortgagees and other security holders owning or holding 1 per cent or more of the total amount of bonds, mortgages, or other securities are: none. 4. That the two paragraphs next above giving the names of the owners, stockholders and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner, and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

(Signed) A. L. Cole, Business Manager.

Sworn to and subscribed before me this 20th day of March, 1931.

Esther Eyl, Notary Public, Kings County Clerk's No. 57, Registry No. 2065. New York County Clerk's No. 158, Reg. No. 2E117.

(Seal) My Commission expires March 30, 1932.

A definite program for getting ahead financially will be found on page four of this issue.

Masonite makes homes modern

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Masonite Structural Insulation, single or double thick, is inexpensive. It really costs you nothing when you consider the economies it effects, and that its sturdiness enables it to replace other building materials.

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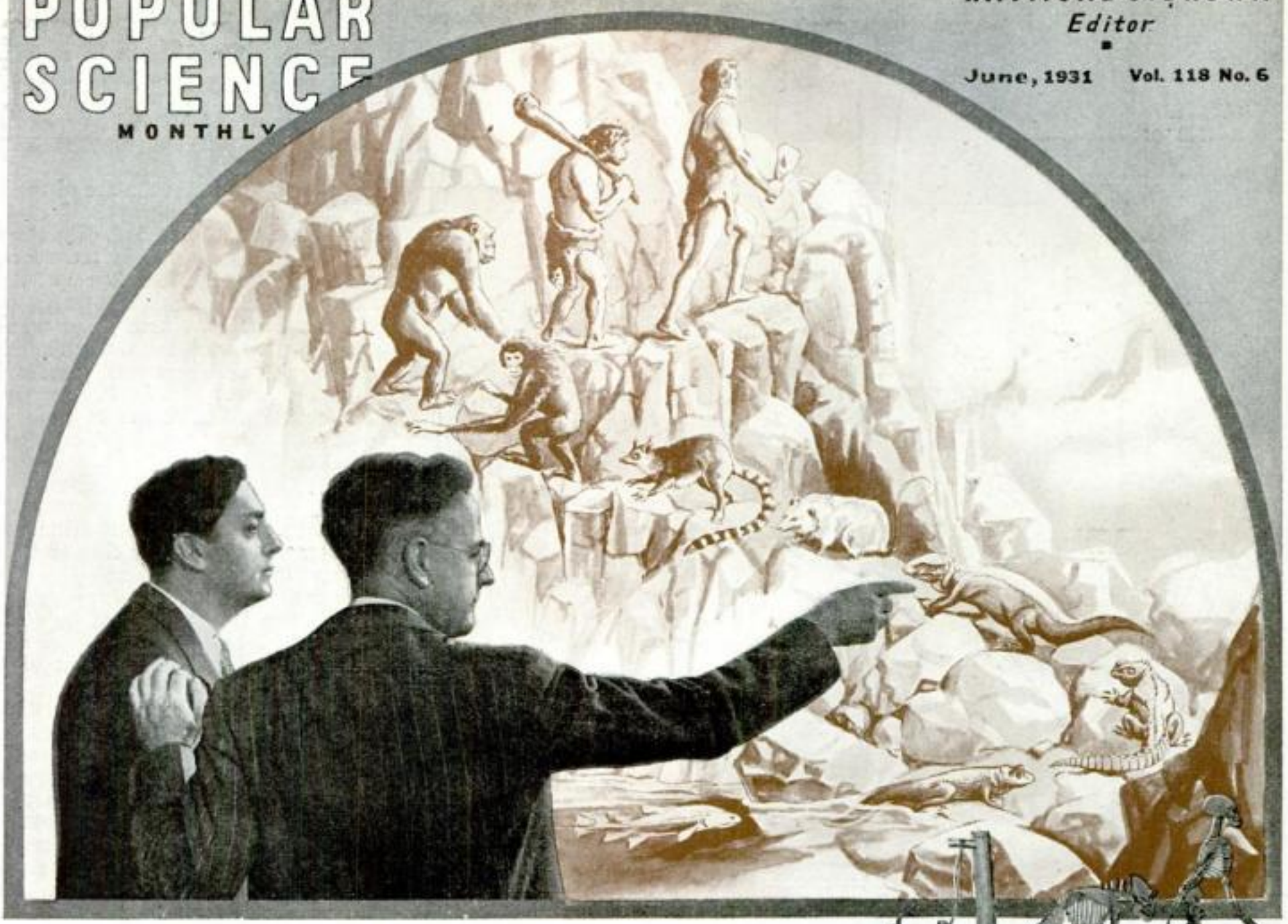
POPULAR SCIENCE
MONTHLY

RAYMOND J. BROWN
Editor

June, 1931 Vol. 118 No. 6



William K. Gregory, right, indicates to Michel Mok the amazing steps in the chain that leads from the lowest forms to man. Below, photos of skeletons show changes from fish to man.

How Man Was Created

THIS is the first of a series of talks between William K. Gregory, world famous scientist of the American Museum of Natural History, and Michel Mok, a staff writer. Facts in the dramatic story of man are given in a manner so gripping that you will never forget them. You will be thrilled by the new and startling statements Dr. Gregory here passes on to you backed by the weight of his years of study and reputation. *Popular Science Monthly* has never before offered you so rare a combination of drama and truth.

First of a Series of Articles That Explain "Life—The World's Greatest Mystery" *Just the Things You Always Wanted to Know*

MR. MOK: Dr. Gregory, can you tell me where man came from and how long he has been on earth?

DR. GREGORY: That is a large question and one that has stirred up a thousand bitter fights. In the old days, they thought they knew the exact answer. For example, in 1641, a great English scholar, Dr. John Lightfoot, vice-chancellor of Cambridge University, announced that man was created on October 23, 4004 B.C., at nine o'clock in the morning.

MR. MOK: But surely, nobody believes anything like that nowadays?

DR. GREGORY: You are greatly mistaken. Thousands do. The only difference is that now they have dispensed with the exact date and the hour of the day.

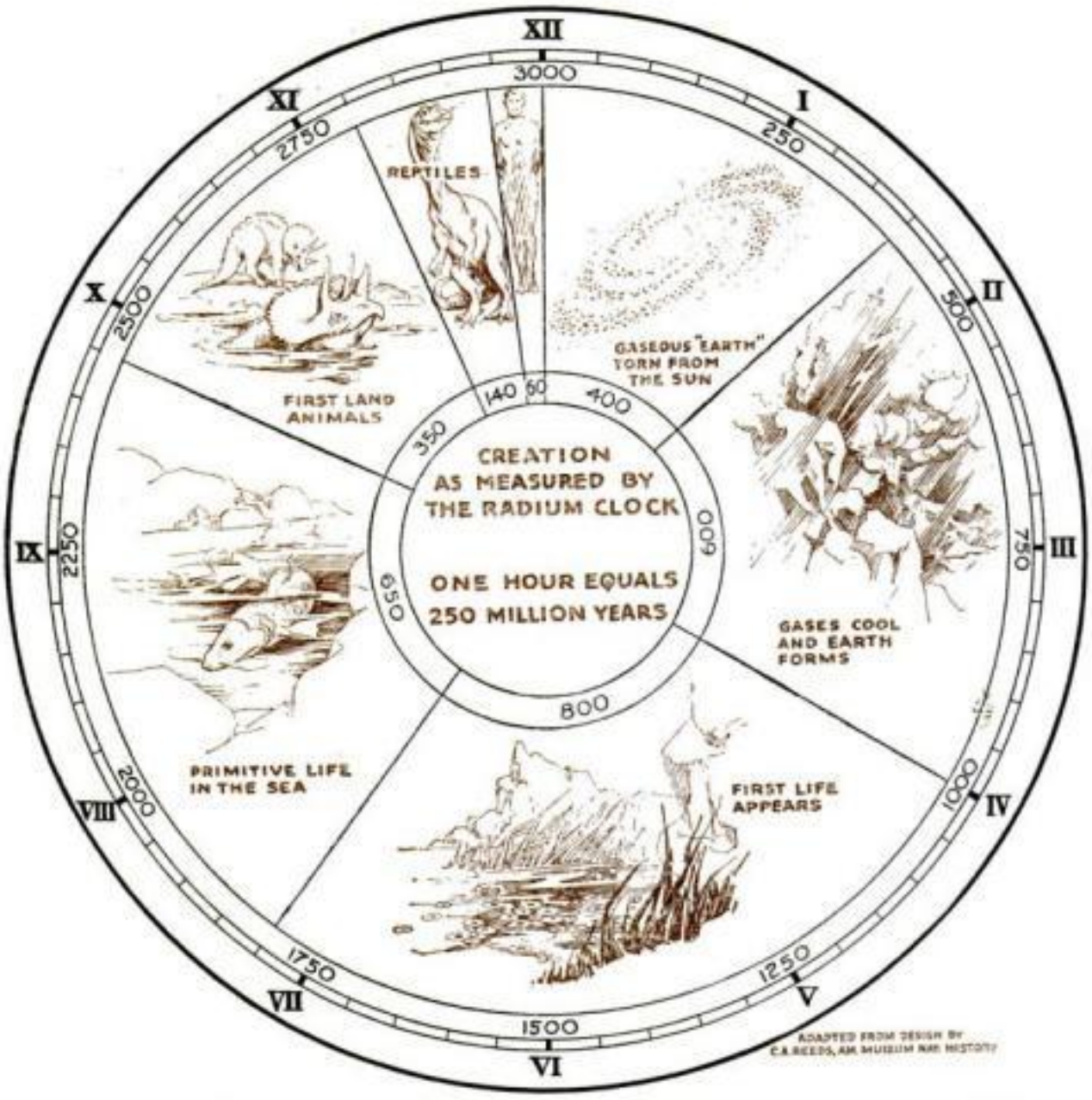
MR. MOK: What do you believe?

DR. GREGORY: Scientists do not reach their conclusions on the basis of beliefs. They must have evidence. Modern science has plenty of evidence to prove that man was created, or that he evolved—the choice of words is a matter of individual opinion—by extremely slow stages over a period of more than a billion years. Have you any idea of what a billion years means?

MR. MOK: I have not.

DR. GREGORY: Neither have I. Nobody has. Figures like that stagger the imagination. Just realize that only a little more than one billion *minutes* have passed since the birth of Christ!

MR. MOK: But you don't mean to say that there were men living on earth



a thousand million years ago?

DR. GREGORY: Of course not. Man has been here, more or less in his present form, only between five and ten million years. In other words, we parted company with our cousins, the apes, about ten million years ago, and after that went our own way. It seems to me that is such a long time that even the most sensitive person need not feel bad about the relationship. The balance of the billion years was taken up by the slow steps that led up to present-day man.

MR. MOK: How do you know it took that long?

DR. GREGORY: We did not always know it. Thirty, thirty-five years ago, scientists believed that the whole history of life covered only forty million years. It was merely an estimate. They had no way of telling. Since then, we have found a clock.

MR. MOK: A clock?

DR. GREGORY: Yes, or something almost as good. It was discovered for us thirty-three years ago in a laboratory in Paris by a French chemist and his wife, M. and Mme. Curie. I mean radium.

MR. MOK: Can you tell time by radium?

DR. GREGORY: You certainly can. At any rate, radium will tell you the age of a rock.

MR. MOK: What has the age of rocks to do with it?

DR. GREGORY: A great deal. The story of life is plainly written in the rocks. That is to say, in the rock layers of the crust of the earth animals and plants, or their impressions, have been preserved in hardened, or fossilized, form, much in the same way that flowers are preserved between the leaves of a book. Suppose you found an old book full of pressed, dried flowers. How would you find out how old the flowers were?

MR. MOK: By the age of the book.

DR. GREGORY: Right. That is, you would come pretty close to it in that way. In any case, it would give you the age limit of the flowers, for it stands to reason that they would not be older than the book.

MR. MOK: I understand. But what of the rocks?

DR. GREGORY: I am coming to that. Geologists have explored many rock layers. The oldest of these would now lie at a depth of fifty-five miles if they had not been stirred up by volcanic action and earthquakes. In these examinations, they found thousands of fossil treasures. Here was the thrilling story of the development of life. All that was lacking was the time element. Before the discovery of radium, we had, in a manner of speaking, no way of telling when our wonderful "rock book," or rather the fifty-five-mile stack of them, was "published."

MR. MOK: You mean that, if you could find out when the first rock layers were laid down, you would then be able to figure out about how long ago life started on earth?

DR. GREGORY: That's it. Rock, as you know, is nothing but sediment. You cannot have sediment without water. This means that the first rocks must have been built when the earth, which was originally a seething mass of hot gases, had solidified and then cooled down so water could condense. The radium clock has shown us how long ago this must have happened, and how long it must have taken for the later layers of rock to be laid one on top of the other.

MR. MOK: How did radium do that?

DR. GREGORY: In this way:

Thanks to the work of M. and Mme. Curie, above, the discoverers of radium, the world now has a clock, shown at top of page, that can be used to date the steps in man's lost history.

At left, one-celled amoeba. Next, an egg cell from some form of which man, a cow, a snake, a canary, and an ant all develop.

The atoms, or tiniest particles of radium, and also of uranium, the parent element of radium, are explosive. Every minute a certain percentage of them explodes. Each time this happens, certain other elements are formed. The last one of these is lead. Therefore, if you find both radium and lead in the same rock, you can be sure that the lead was produced by the radium. We know how long it takes a given quantity of radium to form a given quantity of lead, and so we can calculate the age of a rock sample from the proportions of radium and lead we find in it. By this method, samples from each of the rock layers have been made to give up the secret of their ages. Those at the bottom of the fifty-five-mile stack confessed to the ripe old age of 1,500,000,000 years.

MR. MOK: But you said life appeared about a billion years ago.

DR. GREGORY: I did. Probably 500,000,000 years went by after the oldest rocks were laid down before life put in its first appearance.

MR. MOK: What do you give as the reason for the long delay?

DR. GREGORY: To answer that question, we have to get right down to what *caused* life. Nobody, of course, really knows. Some scientists have seriously considered the possibility that life came down to earth from another planet.

MR. MOK: How?

DR. GREGORY: They thought it either was wafted down in the form of fine fertilizing dust, filtering through space, or that, perhaps, it was hurled down, hidden in the cracks of some meteorite.

MR. MOK: That would be begging the question, wouldn't it? As I see it, the problem then would be: How did life originate on the other planet?

DR. GREGORY: Quite so. Anyway, few students nowadays believe this actually happened.

MR. MOK: What is the accepted theory today?

DR. GREGORY: Scientists now generally consider it probable that life began right here, and that it was produced by chemical forces that had been at work for thousands of centuries. Here is the answer to your question of a little while ago. That was the cause of the long delay. It took these chemical forces about a half billion years to build up the raw materials of living matter. Chemical combinations were formed that became more and more complex through the ages. Finally, in a chemical climax, you might say, they came to life.

MR. MOK: How do you picture it?

Drawing illustrates present theory of the birth of our planetary system when a star dragged great masses from sun.

Footprints left by prehistoric animals in clay of Arizona. Uncovered and studied they prove strange animals lived there.

Center above, Roy Chapman Andrews studies the jaw of a shovel tusked mastodon found in the desert of Gobi. Directly above, fossil bones of a mastodon dug up in South America.

DR. GREGORY: The first living things probably were tiny blobs of transparent jelly. Until some years ago, it was thought that these little bits of living matter must have floated about on the surface of quiet pools that were splashed inland by the stormy, primeval sea. But I am afraid it was not quite as romantic as that. It is more likely that they appeared in mud and inland ditches as a result of chemical action in the porous outer layers of the earth.

MR. MOK: That surely was a modest start!

DR. GREGORY: Yes, it was humble enough, and you and I probably would not have paid much attention to it if we had been there to see it. Just the same, that was the beginning of all living things—the origin of man.

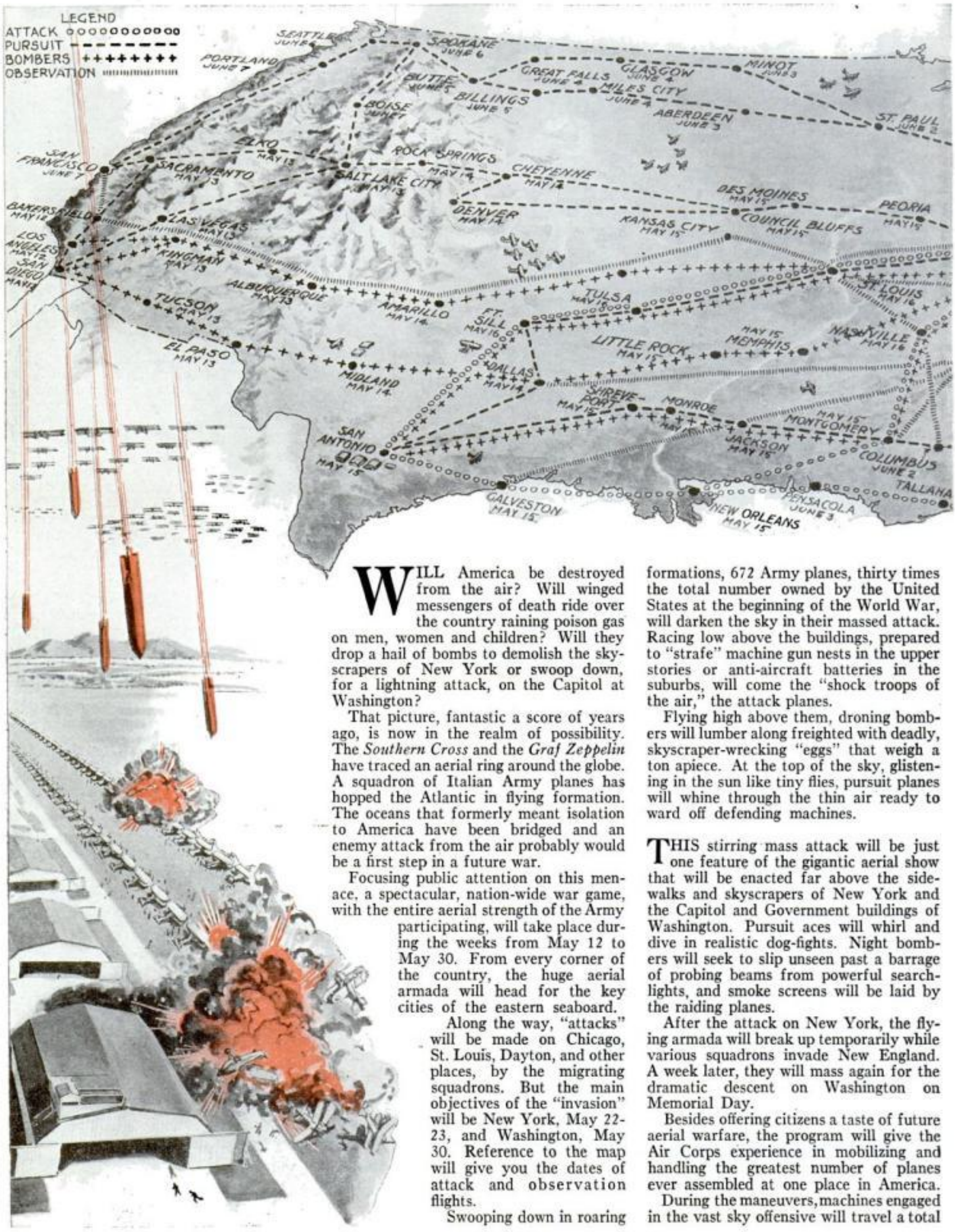
MR. MOK: What do you suppose the earth looked like in those early days?

DR. GREGORY: I think you are safe in picturing it as a mass of lonely, barren rocks and cliffs. Of course, there wasn't a single speck of green, nor a living creature of any kind. Many of the mountains were volcanic, and they were in almost constant eruption. Thunderstorms, gales, heavy rains were daily occurrences. The land was rocked continually in violent earthquakes.

MR. MOK: Not a very attractive place. Why all the quakes?

(Continued on page 135)

Can Enemy Planes



WILL America be destroyed from the air? Will winged messengers of death ride over the country raining poison gas on men, women and children? Will they drop a hail of bombs to demolish the skyscrapers of New York or swoop down, for a lightning attack, on the Capitol at Washington?

That picture, fantastic a score of years ago, is now in the realm of possibility. The *Southern Cross* and the *Graf Zeppelin* have traced an aerial ring around the globe. A squadron of Italian Army planes has hopped the Atlantic in flying formation. The oceans that formerly meant isolation to America have been bridged and an enemy attack from the air probably would be a first step in a future war.

Focusing public attention on this menace, a spectacular, nation-wide war game, with the entire aerial strength of the Army participating, will take place during the weeks from May 12 to May 30. From every corner of the country, the huge aerial armada will head for the key cities of the eastern seaboard.

Along the way, "attacks" will be made on Chicago, St. Louis, Dayton, and other places, by the migrating squadrons. But the main objectives of the "invasion" will be New York, May 22-23, and Washington, May 30. Reference to the map will give you the dates of attack and observation flights.

Swooping down in roaring formations, 672 Army planes, thirty times the total number owned by the United States at the beginning of the World War, will darken the sky in their massed attack. Racing low above the buildings, prepared to "strafe" machine gun nests in the upper stories or anti-aircraft batteries in the suburbs, will come the "shock troops of the air," the attack planes.

Flying high above them, droning bombers will lumber along freighted with deadly, skyscraper-wrecking "eggs" that weigh a ton apiece. At the top of the sky, glistening in the sun like tiny flies, pursuit planes will whine through the thin air ready to ward off defending machines.

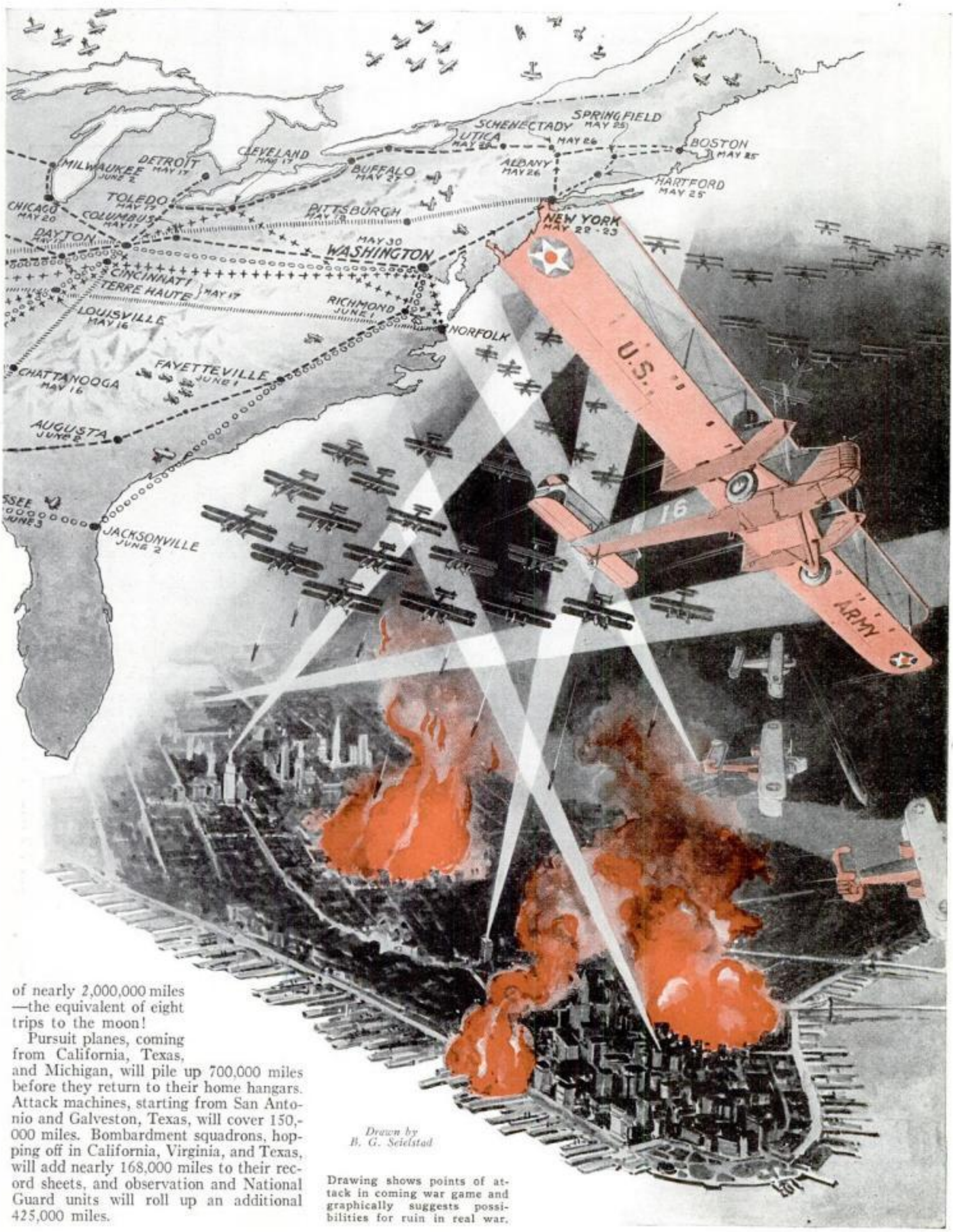
THIS stirring mass attack will be just one feature of the gigantic aerial show that will be enacted far above the sidewalks and skyscrapers of New York and the Capitol and Government buildings of Washington. Pursuit aces will whirl and dive in realistic dog-fights. Night bombers will seek to slip unseen past a barrage of probing beams from powerful searchlights, and smoke screens will be laid by the raiding planes.

After the attack on New York, the flying armada will break up temporarily while various squadrons invade New England. A week later, they will mass again for the dramatic descent on Washington on Memorial Day.

Besides offering citizens a taste of future aerial warfare, the program will give the Air Corps experience in mobilizing and handling the greatest number of planes ever assembled at one place in America.

During the maneuvers, machines engaged in the vast sky offensive will travel a total

Wipe Out America?



of nearly 2,000,000 miles —the equivalent of eight trips to the moon!

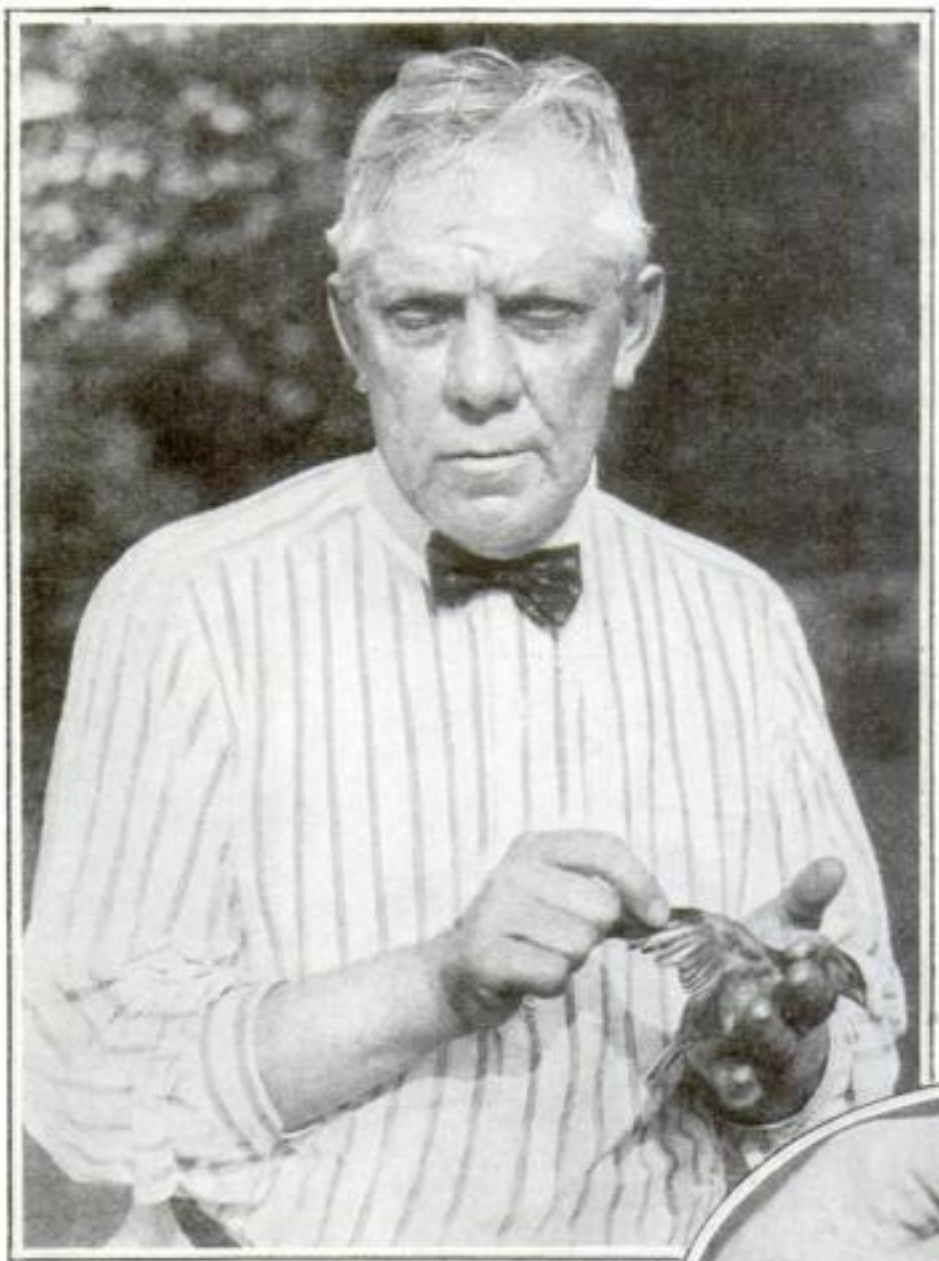
Pursuit planes, coming from California, Texas, and Michigan, will pile up 700,000 miles before they return to their home hangars. Attack machines, starting from San Antonio and Galveston, Texas, will cover 150,000 miles. Bombardment squadrons, hopping off in California, Virginia, and Texas, will add nearly 168,000 miles to their record sheets, and observation and National Guard units will roll up an additional 425,000 miles.

Drawn by B. G. Seielstad

Drawing shows points of attack in coming war game and graphically suggests possibilities for ruin in real war.

Whispering Wires Catch Birds' Strange Secrets

By WALTER E. BURTON



S. Prentiss Baldwin, whose interest in birds led to the building of a big refuge for them.

Birds soon get to know their friends, especially if they are handled by one who knows how, as above.

S. Charles Kendeigh, Baldwin's associate, above, is trapping a house wren.

HILLCREST FARM, Gates Mills, Ohio. To the compiler of statistics, that may mean just one of 6,371,640 farms listed in the United States. But, to birds, it is an address to remember.

It is the home of the Baldwin Bird Research Laboratory, unique among American institutions. Scattered over its green acres are strange bird houses wired with electricity; nests containing thread-like thermocouples, reporting the temperature of eggs and of nesting wild birds during incubation; seesaw perches, making electrical contacts that record the coming and going of shy feathered folk; and even microphones that amplify the heart-beats of a tiny bird on a distant nest. It is a wonderland of scientific apparatus; a far-flung laboratory in which are being written new pages in the volume of our information about our feathered neighbors.

Around the farm, S. Prentiss Baldwin, the owner of the extensive bird refuge, has built high woven-wire fences to keep out stray cats and dogs. The birds that come to Hillcrest Farm are regularly fed and are protected from their natural enemies. Consequently, when the spring migrations begin, more homing birds steer their flight for this farm than for any other spot of similar area. The bird population is said to be denser here in summer than anywhere else in the United States.

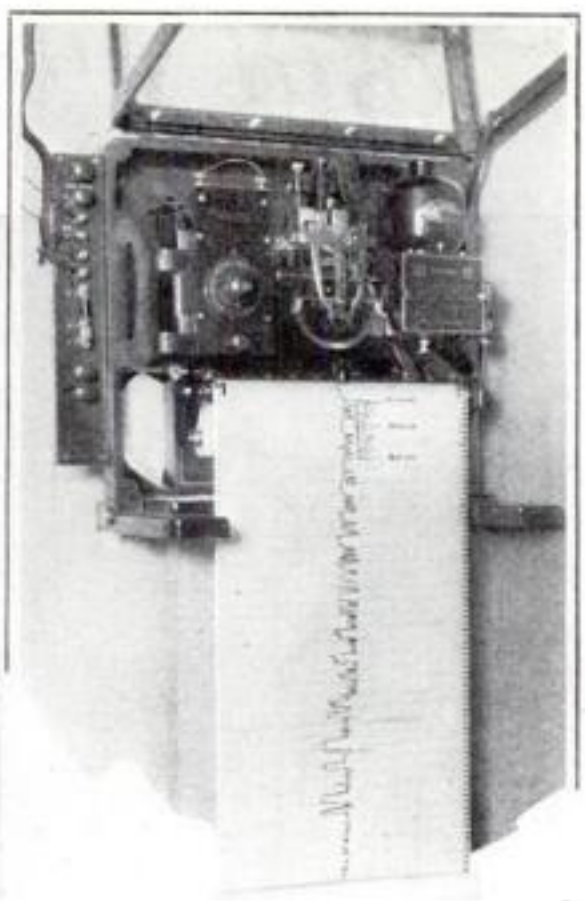
An invasion of English sparrows seventeen years ago started Baldwin on his bird investigating hobby. He decided to rid his farm, which is a few miles east of Cleveland, of the quarrelsome feathered pests and constructed a sparrow trap. He found that other birds were captured in the wire inclosures as well as sparrows. After a time, he conceived the idea of placing numbered metal bands on the legs of those caught in this way so he could recognize them if they came to the traps a second time.

ALTHOUGH bird banding was not new, having dated from about 1803 when John James Audubon, the famous American ornithologist, placed silver strings about the legs of a brood of phoebes, it is Baldwin who is given credit for developing the systematic trapping now used in such work. When the U. S. Bureau of Biological Survey took charge of bird banding, several years ago, Baldwin's methods and some of the equipment which he devised were adopted by the Bureau.

At present, a chain of bird banding stations under the direction of the Bureau extends from coast to coast. A Federal permit is required to catch wild birds for banding and they must be released immediately after the metal rings have been snapped on their legs.

A record of all birds marked at each station, and of all birds caught that had previously been banded, is forwarded at frequent intervals to the Washington headquarters. This file is disclosing valuable facts about the movements of

It was with traps of this sort, set for sparrows, that Baldwin first started on his hobby that has become a life work.



Here's the machine that, by recording nest temperatures, keeps tab on the mother birds.

birds, their lanes of migration, their speed of travel, and similar matters.

But there are many things that banding will not show; many mysteries it will not solve. The more Baldwin learned, the more insatiable grew his curiosity about the everyday life and habits of birds. He wanted to know, for instance, if day birds ever go out at night; how many times nesting females leave their eggs in twenty-four hours; what are the temperatures of eggs and brooding birds; and how many times a minute a bird's heart beats when it is unobserved and under normal conditions.

THESE, and other bits of information, he set out to add to the world's stock of birdlore. In doing so, he has gathered about him a corps of expert assistants, developed a farm laboratory unlike anything else in existence, and has become recognized as a foremost authority in the field of ornithology.

One of his first attempts to see "back stage" in the lives of his feathered friends resulted from curiosity about wrens. As long as they were outside their houses, he could observe their ways and habits easily. But once they entered the wren house, with an impudent flip of a tiny tail, a curtain was drawn over their activities.

Baldwin resolved to draw back that curtain. So he built special wren houses with backs of glass. These were placed over openings in the side of a laboratory building, and inside, over each opening, he fastened a section of stovepipe with a pierced cardboard cover over the end.

This kept the wren houses dark but permitted an observer to look through the hole in the cover and for hours at a time watch the nesting activities of the birds. But the plan had its disadvantages. The birds could not be watched at night, and one man could attend to only one house at a time.

A frequent visitor at Hillcrest Farm, at this period, was Baldwin's nephew, Dr. Charles Baldwin Sawyer, now head of the Brush Laboratories of Cleveland. He suggested substituting mechanical watchers to solve the problem.

The first of these electrical devices which he helped produce consisted of a thermocouple—fine copper and nickel-copper alloy wires registering the amount of heat by the strength of the current they produced—attached to a pen that recorded the variations in temperature on a roll of paper passing beneath the pen at the rate of four feet a day. The threadlike wires were stretched across the interior of the wren house just above the eggs, if there were any.

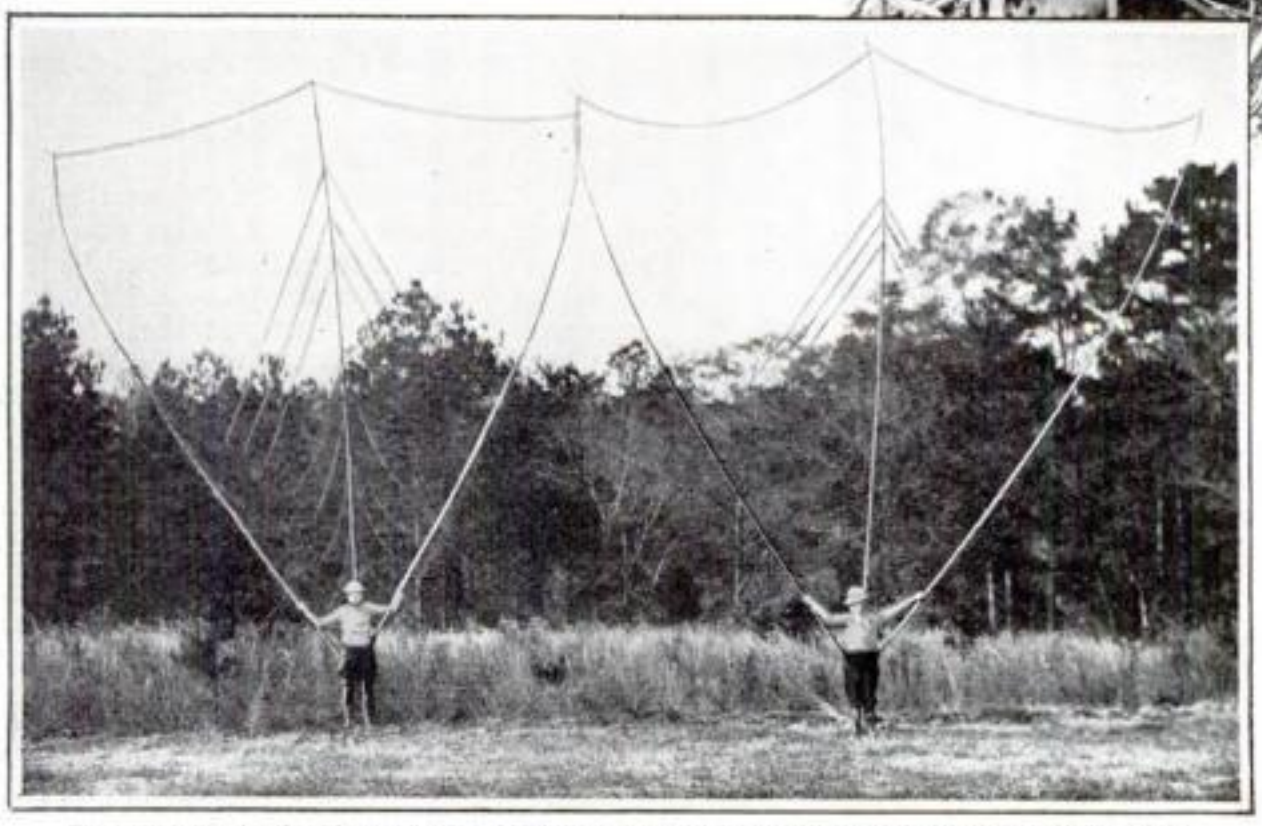
AS SOON as the mother bird entered the house and settled on the nest, the heat of her body caused an immediate rise in the temperature of the thermocouple, and this was recorded on the graph by a movement of the pen. Similarly, when the bird left the nest, the temperature dropped and the pen moved down the scale. The device showed the exact time of such changes, and indicated the temperature difference to within one degree Fahrenheit. Thus an unbroken record of the coming and going of the mother birds at several nests could be obtained over a period of days. It indicated exactly how often and for how long they left their incubating eggs.

Take the case of Wren Number 71,653. The graph in the laboratory showed that on a typical day during incubation, she left the nest some forty-three times. She was on the nest about fourteen minutes and off about six minutes of each twenty-minute period. And her coming and going was with considerable regularity.

On the day all the little eggs were hatched, she exhibited great restlessness. Then, when the brood appeared, she returned to more normal routine, and eventually, having sent the young ones into the world by themselves thirteen days after they first left the nest, both she and her mate apparently forgot them and turned to other duties.

It was this same wren that made a mysterious night disappearance, which the graph recorded, answering one of Baldwin's questions: Do day birds ever go out at night? When he came to the laboratory one morning to look over the records, he found that Number 71,653 had remained on her nest as usual until 8:50 P.M. Then she had "stepped out" for the night and had not returned until 1:04 the next morning!

Compared to other wild birds, Baldwin and his associates found that nestling wrens are cold-blooded. Their temperatures vary from forty-seven to 115 degrees F., *(Continued on page 150)*



Into these queer looking nets quail fly and are caught for banding without harming them. Center, above, a gunless hunter is banding the leg of a captured duck in the midst of reeds.

TONY FOKKER *and the* World War

Many startling things had happened before Fokker, right, and the former Kaiser, left, met and were photographed in Holland after the war.

Fokker at the front during World War.

Air Battles Given New Fury When Dutch Boy Hooks Machine Gun to Propeller—Rivals Plan His Ruin

By ROBERT E. MARTIN

ONE Tuesday evening in 1915, an excited young man leaped aboard a train pulling out of the Berlin station for northern Germany. He was Anthony Fokker, Dutch designer of fighting planes. Under his arm was a precious bundle destined to revolutionize battles in the sky.

Fokker was a man of the hour, world famous, barely twenty-five. Born in a jungle village in far-off Java, brought to Holland at the age of six, he had built a successful aircraft before he had ever seen a plane in the air. He had peddled his machine, of advanced design, vainly through Europe. England turned it down, Russia followed suit, Italy rejected it, and even his native Holland bought planes of another type.

Fighting a dogged, uphill battle, he had won an open competition in Germany and had established himself as a manufacturer just as the war began. With the opening of hostilities, his factory at Schwerin hummed with activity. It was the nest that hatched a thousand mounts for the aces of the Black Eagle. As a neutral, Fokker sold his planes to the only customer who would buy.

A few days before he dashed into the Berlin station, a mysterious French monoplane was forced down back of the German lines. For more than a week, this enigma plane had been wrecking Teuton ships with clocklike regularity. It would dive on an enemy, its propeller spinning an almost solid disk at its nose.

As no plane with propeller in front had ever fired a machine gun forward without shattering the blades, the Germans would scuttle off feeling secure as long as their pursuer was behind. Then a sudden burst of lead, spitting apparently from the propeller itself, would overtake them, and their broken ships would rocket downward to bury themselves in the pock-marked No Man's Land below.

ARTILLERY concentrated on the deadly single-seater every time it approached the lines. German aces, in roaring V's, patrolled the sky looking for the marked marauder. But the pilot side-stepped every trap until one day his engine choked over enemy territory. Before he could apply a torch to his ship and destroy its secret, on landing, it was in the hands of the Germans.

When experts examined the captured plane, they realized the chances this lone marauder had taken. He was Roland Garros, ace of pre-war birdmen, who had barnstormed America with the Moisant Flyers in 1911, and set a string of world records in 1912-13. Nearing the final stages of a fatal lung infection, Garros welcomed the war, ready for any hazard.

SO THE mystery plane was built for him. Its machine gun blazed directly into the path of the whirling propeller. But in line with the fire, sharp wedges of steel, with apexes facing the gun, had been fastened to the rear of the wooden blades to deflect bullets striking them.

There was always the danger that the impact of bullet against wedge would jar loose the propeller, or that ricocheting lead might even strike the plane itself. Even so, the crude, chancey makeshift sent enough bullets between the whirling arms of the wooden screw to crown Garros momentary king of the air.

Berlin officials sent for young Tony Fokker. They wanted him to adapt a similar device for German pursuit planes. With the machine gun under his arm, the first he had ever had in his hands, he rushed home. He had only a vague idea of how it worked, and of its mechanism he knew nothing.

Forty-eight hours later, he returned to Berlin with a revolutionary invention—the synchronized machine gun used in all subsequent aerial warfare.

Without sleep, and hardly taking time

Fokker, in checked suit, friend of the great ace, Richthofen, center, wearing iron cross, in photo taken during the war. At right, Richthofen, wounded, meets Kaiser.

It was with money like this, which he printed himself, that Fokker paid the men who worked in his airplane factory during the war.

Before the war ended, Fokker, left above, was a German officer and here he is seen in uniform of his rank. At left, Fokker and Crown Prince.

to eat, he worked on an idea that had popped into his head on the way from Berlin. Why not let the propeller fire the gun? The problem he had to solve was to shoot between the blades, which on a two-bladed propeller passed a given point 2,400 times a minute.

THE gun must not be fired as long as one of the blades was directly in front of the muzzle. The obvious thing to do was to make the propeller fire the gun instead of having the pilot try to shoot between the whirling procession of blades.

For a temporary device, Fokker attached a small knob to the propeller so it struck a cam each time it revolved. This cam, hooked to the hammer of the machine gun, fired each bullet automatically just after the blade had passed the muzzle.

Dawn was breaking when his crude, experimental device was finished. Turning the propeller slowly, he found it fired the gun cleanly between the blades. The basic idea of the synchronized machine gun had been found.

Late Thursday evening, he put the finishing touches on his invention and installed it on a small monoplane, so the pilot could throw the gun into action by pressing a small button. Lashing the tail skid of the plane to his eighty-horsepower Peugeot touring car, young Fokker set off, racing over dark, deserted roads to Berlin.

HE CALLED officials to the air field early next morning to see a demonstration. They were skeptical. He went aloft, dove on old wings placed in the open, tore them to ribbons with a torrent of lead. Very fine, they told him, but before they would accept the gun, he would have to prove it could bring down an enemy plane. He protested. They were adamant. So he started for the front.

A few days later, he saw a lumbering French Farman coming across No Man's Land. With his gun sights trained on the big machine, he dove. The two Frenchmen watched him curiously, unaware that in the space of a dozen watch-ticks, a hail of lead might be ripping through their wings, puncturing their gas tank, sending them careening to earth.

In imagination, Fokker could see it all happening. As he dove, he recalled his own narrow escapes from death—when his gas tank exploded, when a wing broke over Johannisthal, the Berlin airport, four years before, and his passenger was killed. That decided him. He swerved aside, roared back to the home field and declared he would give up his gun before he would shoot down someone against whom he had no enmity.

AN ANGRY parley followed. Then it was decided that Boelcke, ranking ace of the German birdmen, should fly the new machine across the lines. In his first dog-fight, Boelcke demonstrated the deadly success of Fokker's gun.

Immediately, all German pursuit planes were similarly equipped. Allied airmen were helpless before the new invention until a German pilot, lost and bewildered by fog, landed squarely on a French airport. Then the secret of the new gun was out.

It was only a few months after demonstrating Fokker's gun that Boelcke met death through a strange twist of fate. Forty victories in the sky were credited to him at the time of his death. In the end, a team mate crashed into his ship in mid-air. With one wing torn completely away, the Saxon Eagle plunged to earth.

At his Schwerin plant, Fokker was kept hopping from morning until night, building guns and planes. His little factory was inadequate. He took over a prison barracks, then a piano factory. His workmen increased from 160 to 1,600. They referred respectfully to their youthful boss as "the old man."

High government officials, coming to the plant, mistook the youngster who greeted

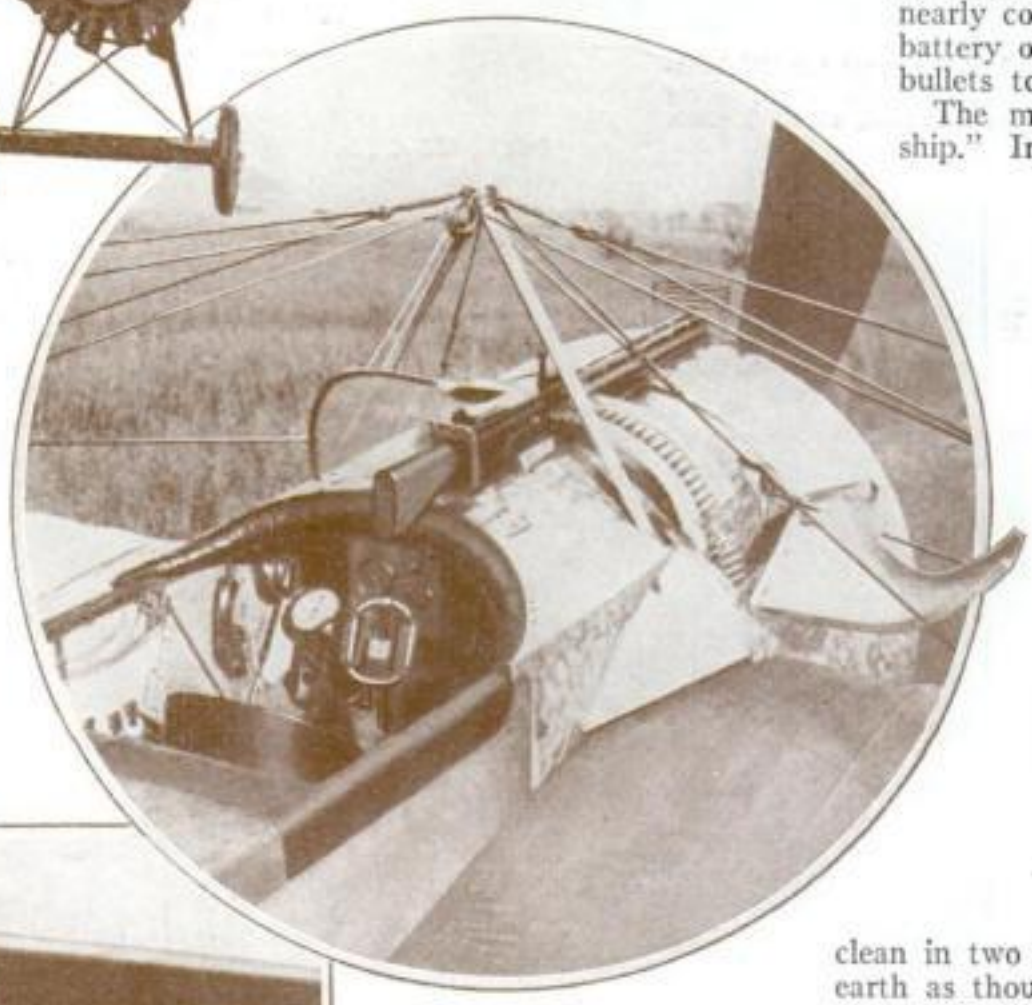
Here is the famous D-7, most widely used of Fokker planes. He designed this machine to defeat a rival airplane firm.

At left, the D-8, which is generally regarded as best fighting plane of the war.

them for a subordinate and when he told them he was Fokker, they replied it must be his father they wanted to see. It was great sport for the Dutch boy, who, less than a dozen years before, had been kicked out of school as a boy who would never learn.

WHEN the war began, Germany bought every plane and motor Fokker had. The army and navy turned Schwerin into a battleground, fighting to get Fokker machines. Price was no object. Orders came in an avalanche. A flood of gold poured in.

Yet Tony continued to live in the same cheap rooms he had taken when he first came to



Here is the first plane equipped with a propeller to fire the machine gun between blades.

Lieutenant Voss, a German ace, and Fokker's triplane. This machine was not fast but it would do things in the air that no other plane of the time could and was a powerful weapon.

Schwerin. He shared them with the chief pilot of the flying school, with his black dachshund puppy, Zeiten, and with Cockoo, a pet ape. This menagerie was soon decreased by one. The insatiable appetite of Cockoo, the ape, extended to everything small enough to put in his mouth, and the lead of a blue pencil proved fatal.

EVERY morning at eleven Fokker, with Zeiten paddling along behind him and poking his black nose into every corner and tool box, would inspect all parts of his factory. On days when Fokker was away, the puppy would solemnly make the rounds by himself at the usual hour.

Like everyone else in Germany, Fokker thought the war would be over in three months. He first repaid all the money his friends had loaned him in the precarious pre-war days. Then he set out to achieve his ambition of accumulating enough capital to finance himself as a builder of commercial planes when the war ended. He had no idea that before that time came, more than 7,000 Fokker fighters would have been turned out.

HE BUILT one type of plane especially for Max Immelmann, the iron-nerved young flyer who originated the famed Immelmann turn that bewildered allied airmen during the early days of the war. This machine was a wing-clipped monoplane with three machine guns spitting a withering hail of 1,800 bullets a minute. Fokker always tested his new planes himself, and the trial flight of this one nearly cost him his life. One of the battery of guns jammed and sixteen bullets tore the propeller to shreds.

The monoplane was an "unlucky ship." Immelmann flew it over the lines, brought down two enemy planes, and then the rocker arm on the rotary motor snapped. Flailing through the air like a steel knife, it severed the motor supports, leaving the heavy engine hanging by a single twisted tube. Immelmann landed safely; his time had not yet come.

WHEN it did, it was not the enemy that got him, but his own anti-aircraft guns. Coming in low over the German lines, he was mistaken for a French scout. The sky was filled with a barrage of bursting shrapnel. Flying steel cut his fuselage clean in two and his Fokker plunged to earth as though struck by lightning.

During 1916, Germany realized the war had become a prolonged death-struggle and she redoubled her efforts to gain supremacy of the skies. Fokker was asked to design a new combat ship. He produced his famous triplane fighter.

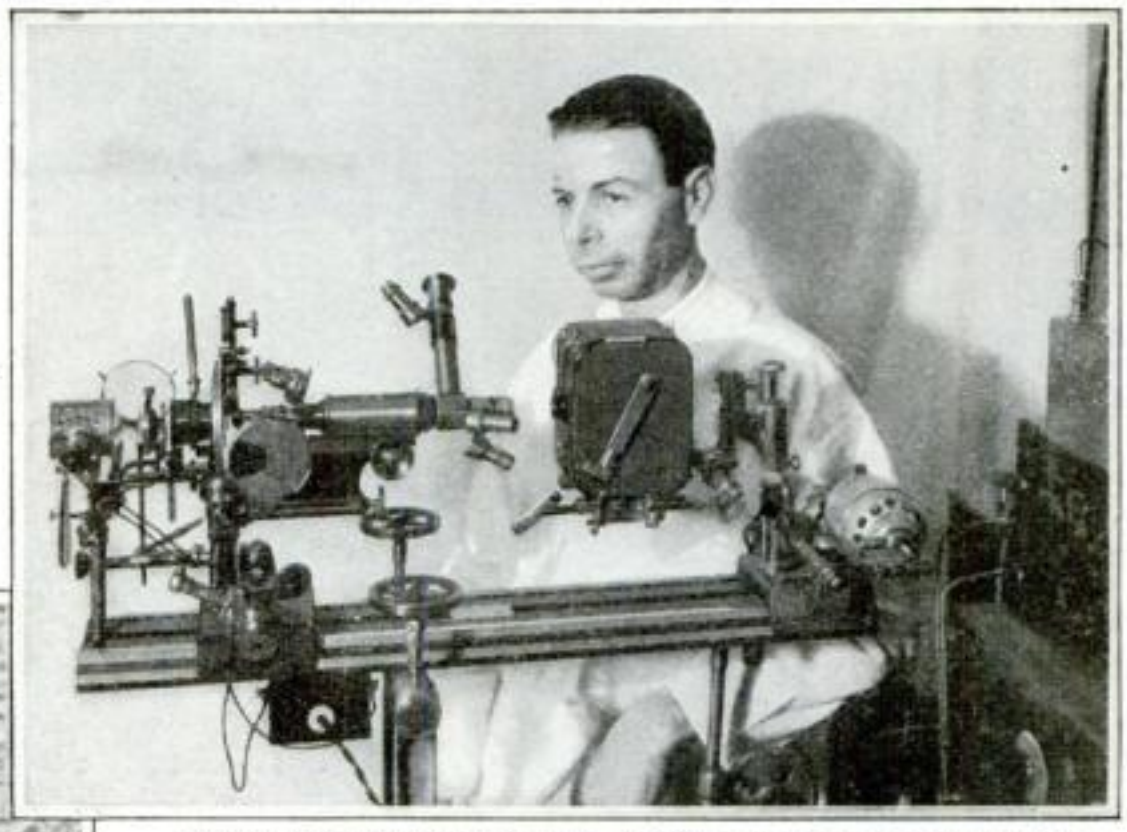
This unique craft, with its three wings one above the other, could dive, twist, and turn as could no other plane of its time. It was slower than the Allied pursuit ships, the Nieuport, Sopwith, and Spad, but its agility in battle made up for its lack of speed.

This Fokker was the favorite mount of the greatest of the aces of the Black Eagle, the almost legendary von Richthofen. In such a triplane, he swept the skies at the head of his "flying circus." Allied planes were often camouflaged. But Richthofen's ship was red—blood-red—from propeller to tail, and the planes of his circus were red, shining in the sun. Each had a distinguishing mark, such as a white rudder or a blue aileron, to set it off from the ship of the Red Knight of the Sky who rode in front.

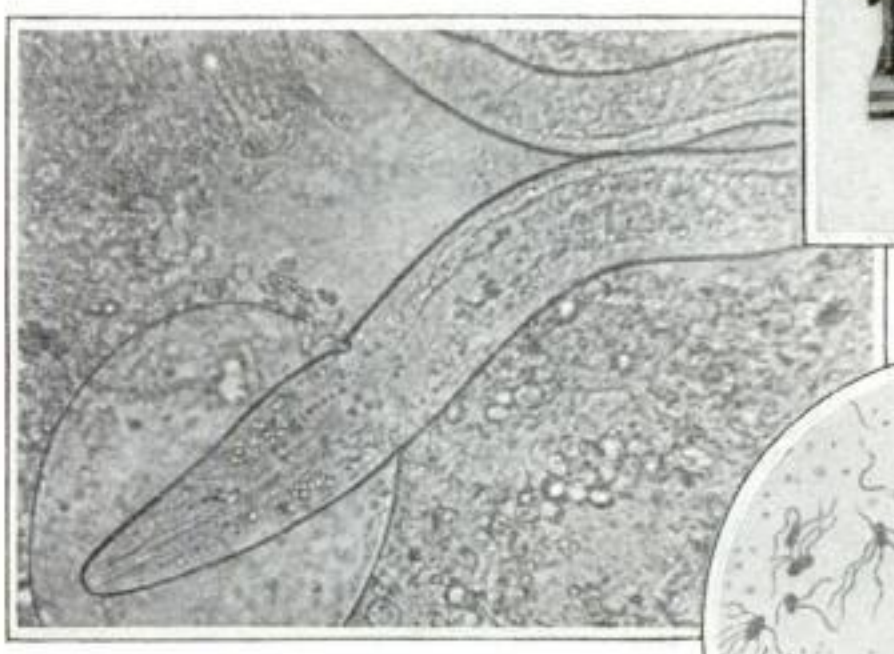
(Continued on page 148)

Movie New Eye of *Microscope* in War on *Germs*

By H. H. DUNN



R. R. Rife, once a chauffeur, has devised a means of preserving with a movie camera the life history of man's most deadly microscopic enemies.



Larva of the hookworm, magnified 12,000 times, is seen just after it has emerged from the egg. At right, bacteria of typhus showing the filaments.

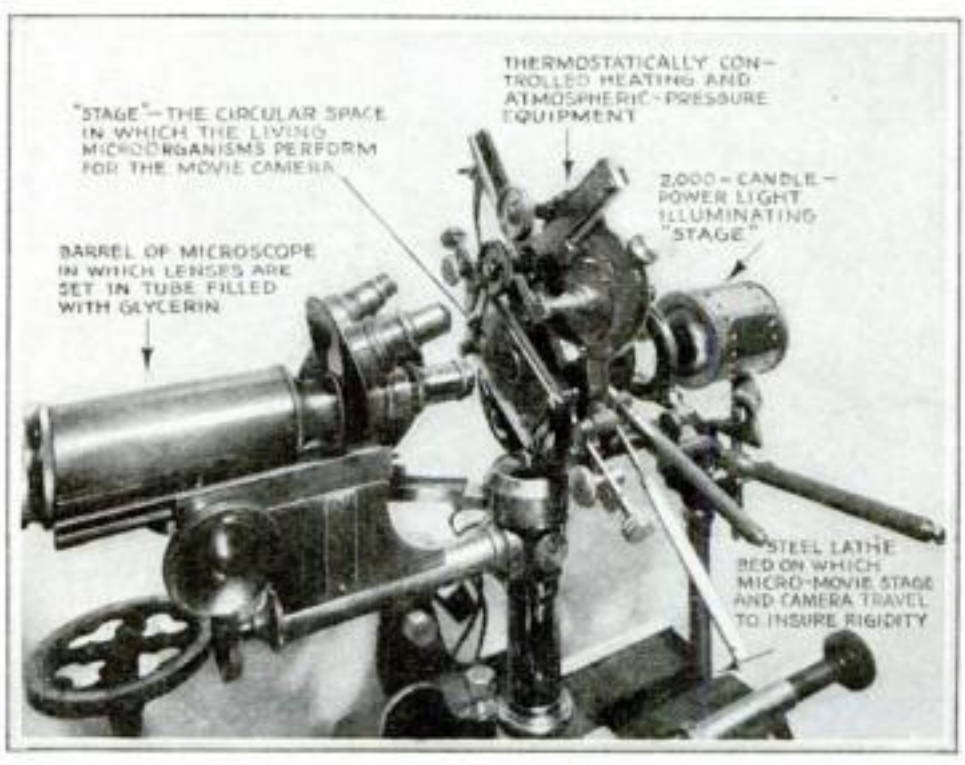
ON A six-by-eight-foot screen in a darkened room appeared a spherical object. It resembled a gray indoor baseball, crisscrossed in all directions by fine threads of silk. Slowly and aimlessly it rotated.

"The spore of the bacterium that causes lockjaw," came a voice from the loudspeaker of the motion picture apparatus. "Watch it!"

A dozen physicians and laboratory workers leaned forward. The sphere swelled. When it had become six inches or more in diameter on the screen, a dark line appeared across its middle. It parted. From it emerged a black bar, nearly as long as the diameter of the spore, spinning on its long axis—the cylinder-shaped germ of tetanus, or lockjaw. For what was probably the first time, a movie had shown the lockjaw spore hatching.

We were in the laboratory of R. R. Rife at San Diego, Calif. He is a pioneer in the art of making motion pictures of the microscopically small. Once he took care of half a dozen automobiles for their wealthy owner, a widely-known physician. Encouraged by the man of medicine, Rife began building his own microscopes in a laboratory fitted up in a room over the garage. In this little room, he has today more than $50,000 worth of microscopes and cameras. Most of them he has built himself.

For ten years he has worked to capture in motion pictures what the eye sees through the most powerful microscopes. He has succeeded and his work has won recognition from the medical profession. Now doctors may sit at ease in comfortable chairs and watch bacteria in their native surroundings on a motion picture screen. There they may compare their own observations of disease germs taken from patients with the life history of these microbes, preserved on motion picture film. It is estimated that the time required to diagnose certain diseases may be cut from days to hours by the use of the films.



It is with this mechanism, in a home built laboratory, that Rife magnifies minute organisms 12,000 times and makes pictures of their activity.

WHENCE come the actors in these strange movies? Rife propagates and rears all the microbes he studies, I learned, in an incubating plant of his own design. Deadly germs, housed in jars, are nursed as carefully as the frailest child. Delicate thermostats control the warmth of ovens in which the germs are kept active, or the coolness of refrigerators in which they lie dormant. "If the electric current holds out," Rife told me, "These microörganisms will be alive a million years from today, without the interference of a human hand."

When he is ready to make a movie, Rife places a small colony of disease germs on a quartz slide. Then he picks up one or more with a human hair, the finest obtainable, which is split lengthwise and mounted in a chuck beneath the lens of his microscope. Slowly he lowers this strange pair of tweezers onto the slide. Its halves part. Between them one or a few microbes lodge. Lifting out the hair, Rife transfers them to the stage of the micro-movie camera, and he is ready to film the life history of a germ.

An electric light of 2,000 candlepower falls upon the center of this microscopic movie studio—a tiny spot on the thin slab of transparent quartz that bears the germs. Above it, sixteen of the finest quartz lenses obtainable, immersed in glycerin, magnify the dimensions of each germ 12,000 times. Designed by Rife himself, this apparatus is one of the most powerful microscopes in the world; its magnification compares with the 2,000-diameter enlargement of microscopes commonly used in research laboratories and in medical examinations.

The small camera at the observation end of the microscope starts. Into this

(Continued on page 141)

Dust, Exploding Like Dynamite, Costs Millions

Many kinds of dust, suspended in the air, form a hazard in American factories. **Above, a plant wrecked** by exploding dust particles.

By EDWIN W. TEALE

IT WAS a little after six o'clock on a March evening. The world's largest grain elevator, a sprawling ten-million-bushel monster of steel and concrete, lay silent on the outskirts of Chicago. Only a night crew of six remained on duty.

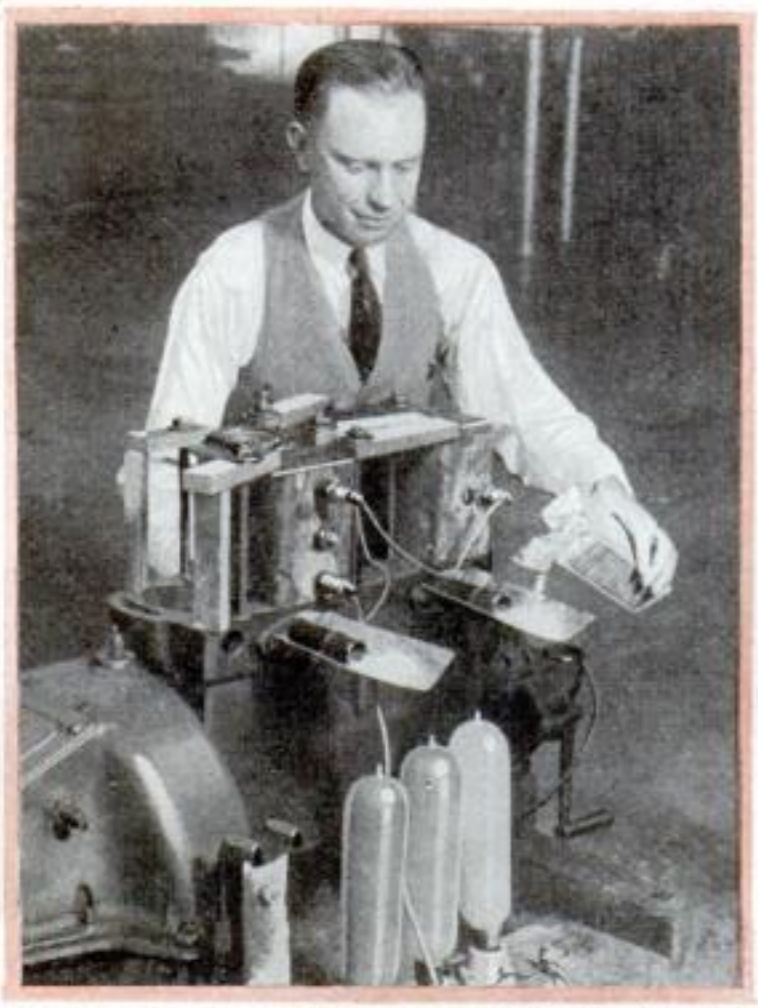
Suddenly there was a terrific blast. Flames roared through broken windows. Walls crumbled like dry crackers. A spark, from an unknown source, in the tunnels beneath the hundred-foot-high storage bins had leaped into the dust-filled air. It had set off an explosive as dangerous as dynamite.

Tearing through solid, reënforced concrete walls a foot thick, twisting structural steel beams, hurling loaded freight cars into the air, and lifting forty storage bins, weighing almost *three hundred thousand tons*, the exploding dust left a trail of wreckage behind it.

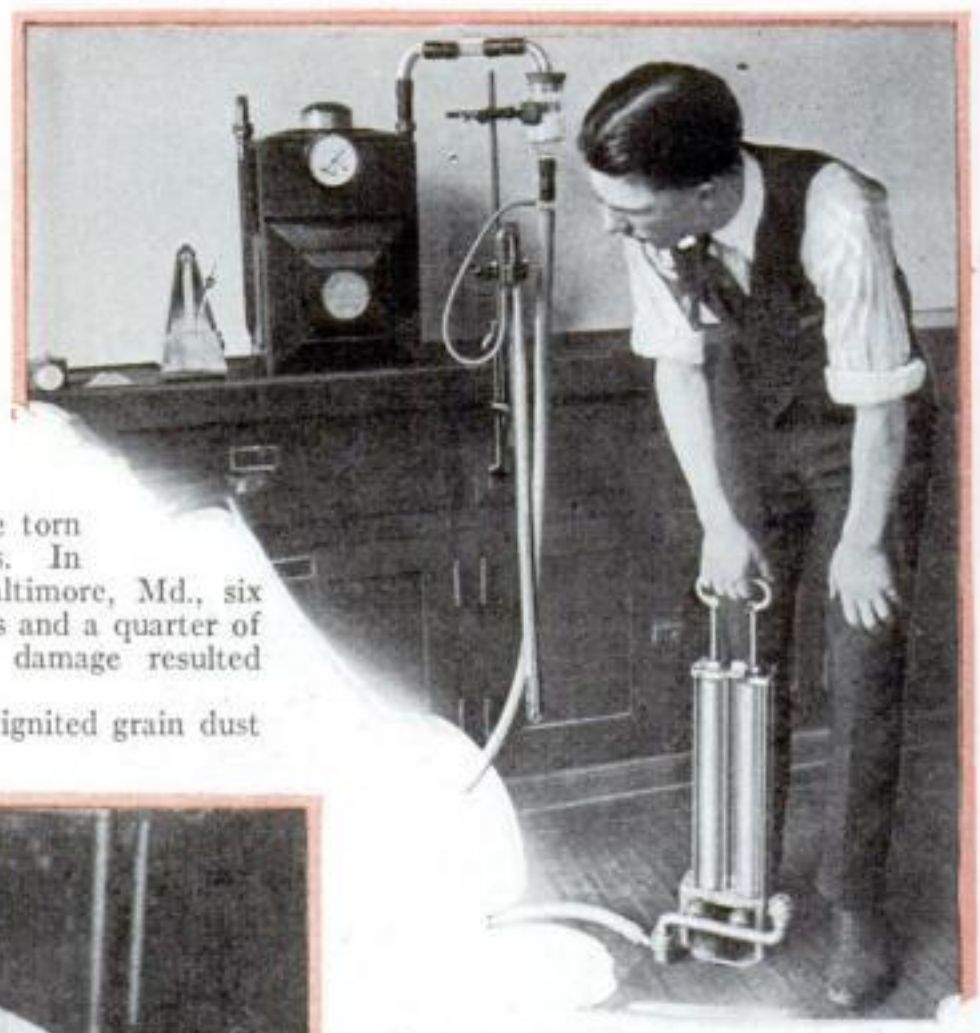
For five miles around, windows were shattered. Tremors of the earth rattled dishes in Benton Harbor, Mich., fifty miles away. And the sound of the explosion carried a hundred miles. In ten seconds, the lives of six men had been snuffed out and the greater part of the huge plant laid waste. Flaming dust had wrought this havoc.

Five times, in one recent month, industrial plants in the United States were torn by dust explosions. In an elevator at Baltimore, Md., six men lost their lives and a quarter of a million dollars damage resulted from such a blast.

Two days later, ignited grain dust turned a Kansas City, Mo., feed grinding plant into a vast infernal machine. The only man who escaped alive was blown through an open door.



Frequent attempts have been made to use highly explosive dust to run engines. Here cornstarch is fed to cylinders.

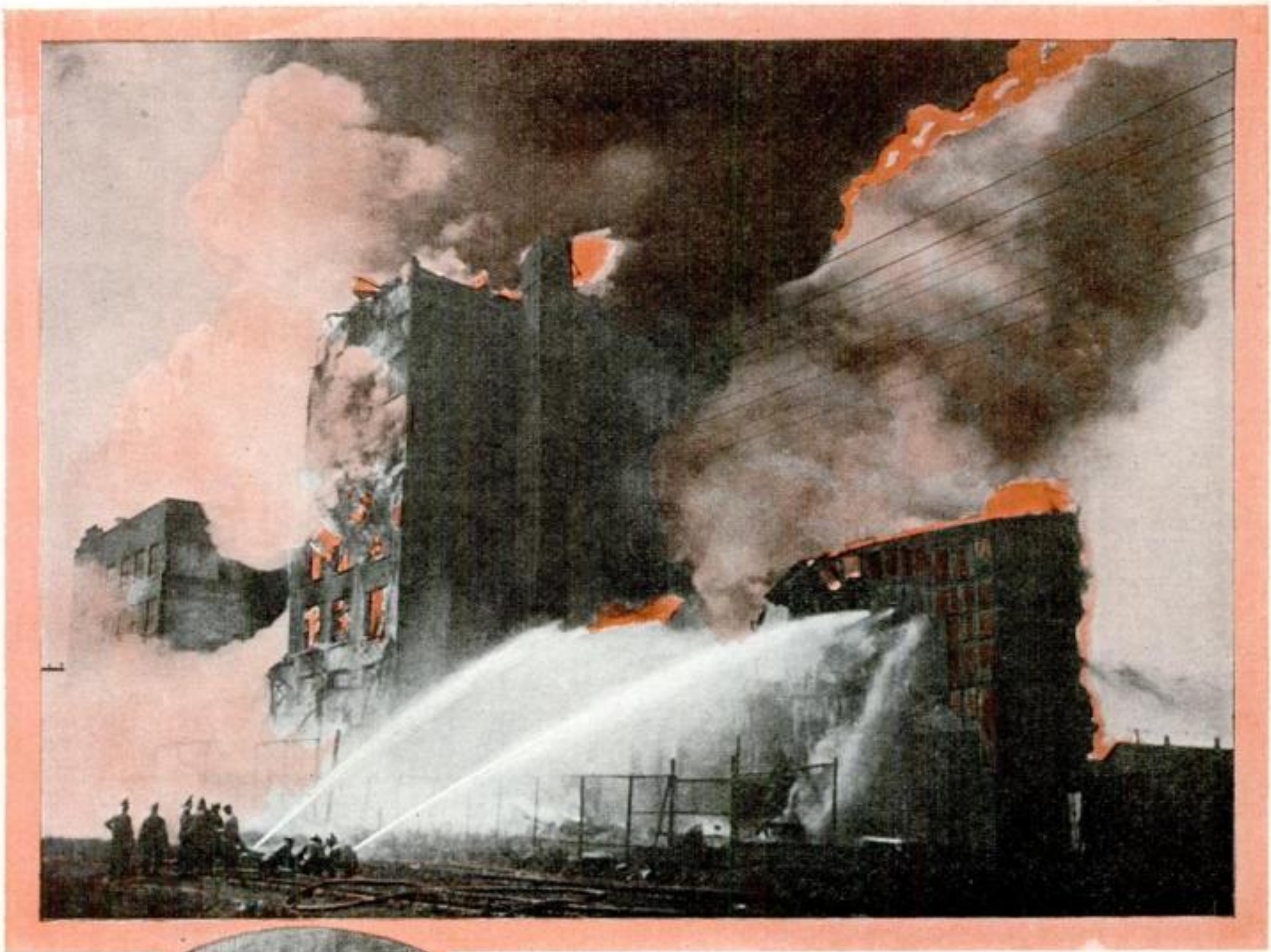


This Department of Agriculture expert is sampling dust to test its explosive nature.

THE same week, another feed mill in Minnesota was wrecked, two lives were lost, and the roof of the structure was hurled 150 feet into the air by a dust-created volcano.

Only a short time later, ignited tobacco dust in a Richmond, Va., factory went on a rampage; and the final disaster of the month, an explosion of starch dust in an Illinois plant, carried six workers to death.

At this moment, in approximately 28,000 plants in America, there is the hazard of exploding dust. A million and a quarter workers labor under the menace of such blasts. The toll of these mysterious detonations, in this country alone,



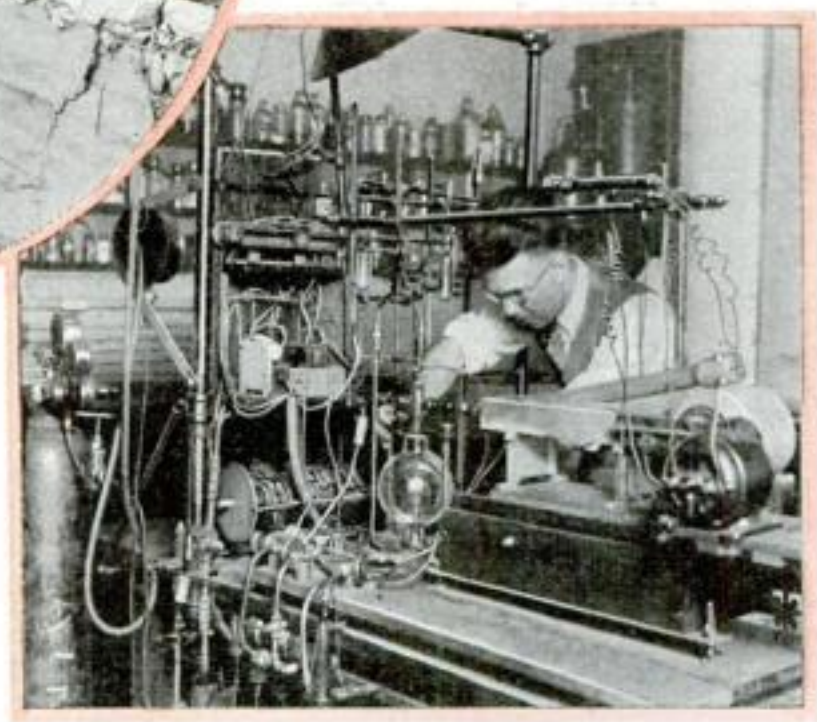
This Wisconsin feed mill, first wrecked by exploding grain dust, was nearly wiped out by the succeeding flames. At left, elevator in which blast lifted forty giant grain bins.

has reached the alarming total of 500 killed, 1,000 seriously injured, and a property loss of $40,000,000.

Investigations made by the U. S. Department of Agriculture show that industrial blasts have been caused by more than twenty kinds of dust. Floating specks of sulphur, sugar, spice, coal, grain, soap, starch, chocolate, leather, and cotton have exploded, wrecking factories and killing workmen.

Pulverized wood, cork, celluloid, pitch, paper, cottonseed meal, dyes, powdered milk, and even such metals as zinc, magnesium, and aluminum are also numbered among the dangerous dusts.

If you plunge a candle into a bushel of wheat, it will go out. But if you strike a match in a room filled with microscopic bits of floating grain, an explosion will wreck the walls.



In this Washington laboratory of the Department of Agriculture, dusts are tested in an effort to find their safety point.

IF YOU throw a bar of aluminum or a cake of soap into the stove, nothing happens. But if you ignite fine soap or aluminum dust, you are touching off an explosive almost as dangerous as T. N. T. What is the explanation?

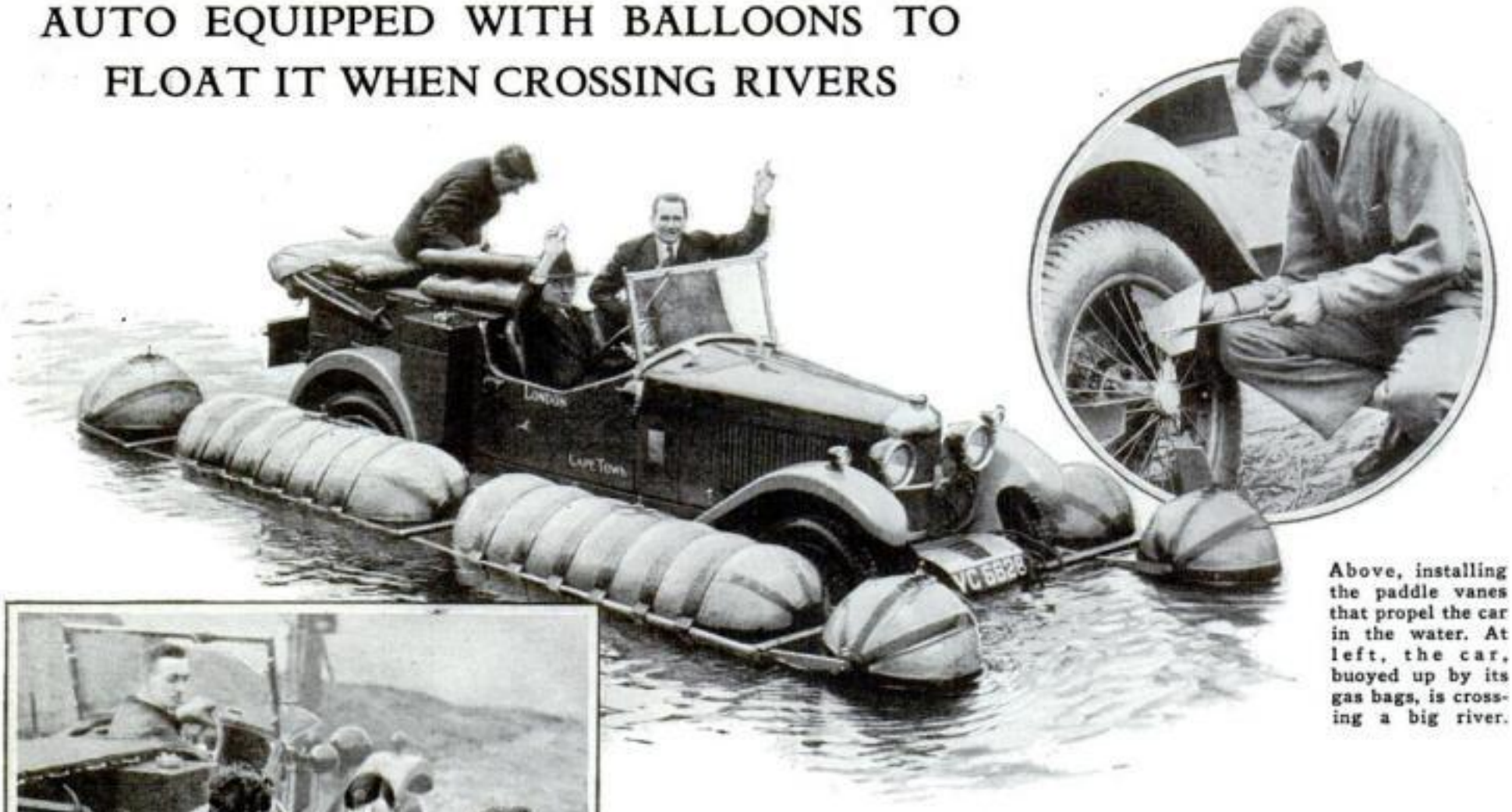
Everyone knows that it is easier to light shavings than kindling, and that it takes less time to ignite kindling than logs. The reason is that in proportion to their bulk, the smaller pieces of combustible material are surrounded by greater quantities of oxygen and consequently are consumed more rapidly.

Dust of any kind is composed of microscopic bits of matter so light that air currents can hold them in suspension. Once ignited, these particles burn with the rapidity of gunpowder. Aluminum, zinc, and other metals, in a finely-powdered state, burn as readily as particles of wood or grain.

A dust explosion is really an extremely rapid combustion of such par-

(Continued on page 144)

AUTO EQUIPPED WITH BALLOONS TO FLOAT IT WHEN CROSSING RIVERS



Above, installing the paddle vanes that propel the car in the water. At left, the car, buoyed up by its gas bags, is crossing a big river.

One of the balloons upon which this auto floats when it takes to water is being inflated with power from the car.

A NOVEL and original auto was tried out in the Severn River in England recently. The car was designed to make an exhibition tour from London, England, to Capetown, South Africa. As an aid in crossing rivers on the long trail, it has been fitted with "balloons" that will keep it afloat. They are connected to a framework surrounding the machine outside its fenders. An ingenious bellows, mounted on the running board and driven off the rear axle, inflates the balloons.

When the car comes to a river across which there is no bridge, the framework is rigged up and the balloons are attached and pumped up. Then the machine is run into the water. When afloat it can be propelled by means of vanes fastened to the rear wheels.

FLYING WEATHER MAN TO AID FORECASTS

IF PLANS of the United States Weather Bureau work out satisfactorily they soon may have a "weather man" flying regularly over Cleveland, Ohio. Manufacturers have been asked to bid for furnishing planes for daily flights to altitudes of five miles on weather recording trips, carrying instruments. Such means of weather observation would result in better forecasts for flyers than they get from ground stations.

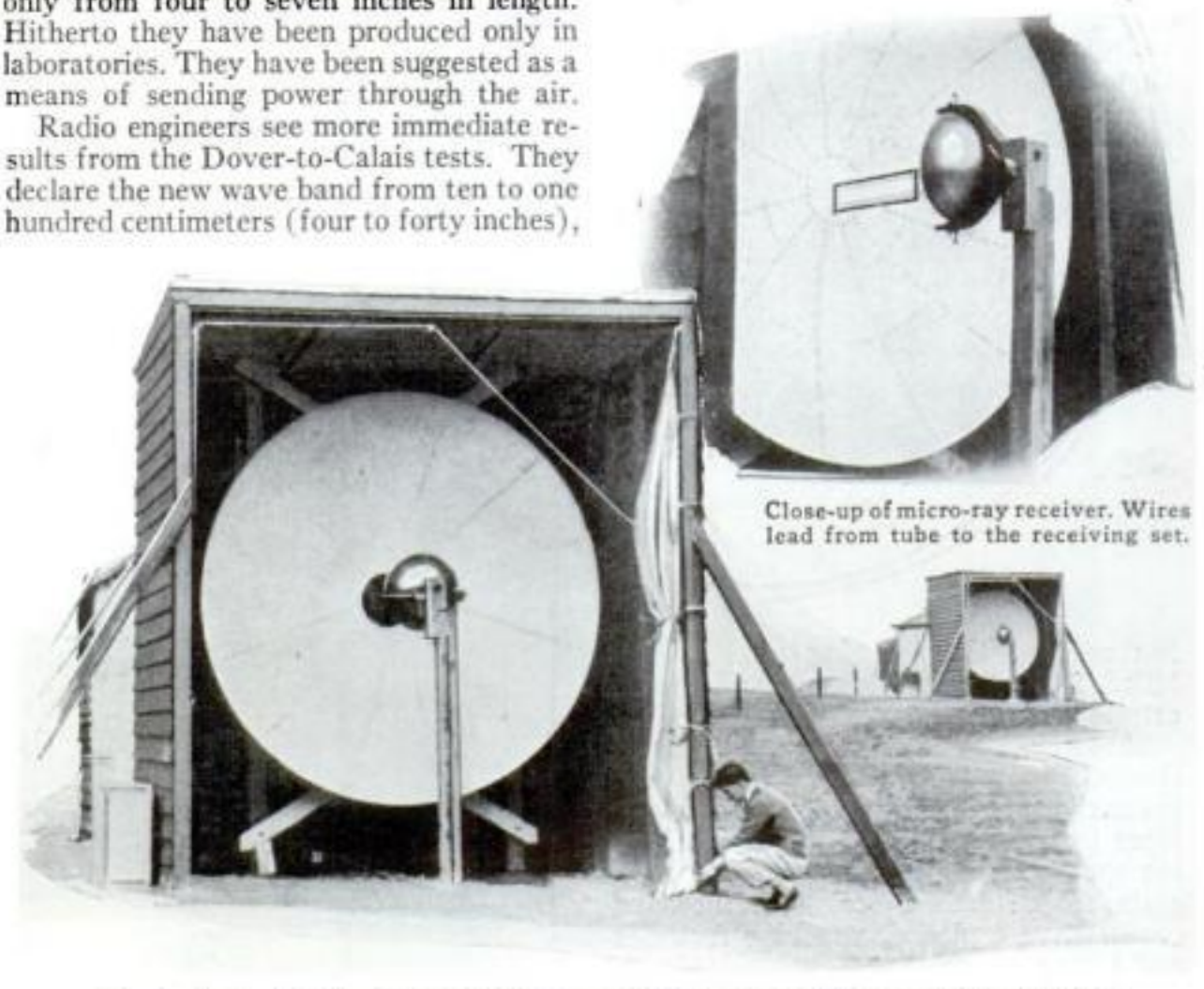
"SEARCHLIGHT RADIO" CARRIES VOICE

AS IF they were pointing a searchlight, radio engineers on the cliffs of Dover, England, recently aimed a beam of radio waves from a ten-foot reflector across the English Channel. It fell on another ten-foot bowl near Calais, France, twenty miles away, and over this beam the men at Dover and Calais talked.

The demonstration proved that a new kind of tiny radio waves, christened "micro rays," are commercially useful. They measure only from four to seven inches in length. Hitherto they have been produced only in laboratories. They have been suggested as a means of sending power through the air.

Radio engineers see more immediate results from the Dover-to-Calais tests. They declare the new wave band from ten to one hundred centimeters (four to forty inches), may end ether congestion, for 250,000 radio stations in a single city could transmit on "micro rays" without interference. Television especially may benefit.

For beam transmission, amazingly little power is used. The Dover transmitter used a special vacuum tube and an antenna less than an inch long, mounted at the focus of the reflector. A hundred yards away, a second reflector picked up incoming signals. Wires led from a detector tube at the reflector's focus to the receiving set. The Calais equipment was identical.



Close-up of micro-ray receiver. Wires lead from tube to the receiving set.

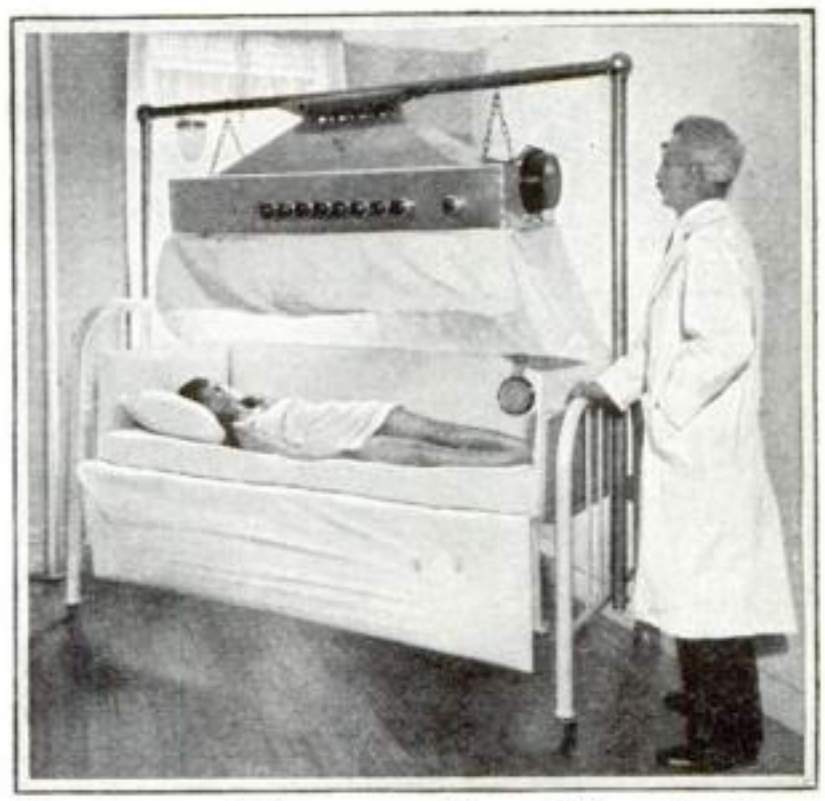
This is the ten-foot bowl that at Dover projected a radio beam across the English Channel so voices were heard in Calais. The receiving outfit is seen in right background.

ANEMIA TREATED WITH IRON AND COPPER MILK

SHEETS of iron and copper are soaked in milk until tiny quantities dissolve, and the result is fed to sufferers from anemia, by an Atlanta, Ga., experimenter. Tests have showed striking benefit from this strange "metallized milk," the discovery of Dr. J. L. McGhee, Emory University biochemist. Through its use a patient can swallow a daily dose of iron and copper of one-fourth the weight of an ordinary postage stamp. The treated milk is not affected in color, odor, or taste, provided the metal is pure. In Dr. McGhee's process the soaking takes twelve hours and is done in the ice box.

SICK ROOM GETS ARTIFICIAL CLIMATE

MOUNTAIN or seashore weather is brought into the sick room by a New York inventor's device. The "climator," as the inventor calls it, is built as a sleeping bed. After the patient climbs in, the curtained top is lowered about him. A uniform atmosphere combining radiant heat, proper humidity, and moving air is continually provided by electric controls, and may be maintained day and night at any season. The patient finds the device comfortable, with plenty of room to sit up for meals, reading, or writing. Attachments supply artificial light and provide for exposure to natural sunlight and to ultra-violet "health rays."



When the cover of this apparatus is lowered, the patient is completely surrounded by an "artificial climate," in which warmth humidity and air movements are constantly regulated by electricity.

LANDS PLANE TO GET HAT

AN EXAMPLE of what may happen in the future when airplanes become more popular was shown near Chicago, Ill., the other day. J. V. Neill was trying out a midget plane when his hat flew off. He saw it land in a back yard. Then he flew down, landed in the yard, got his hat, and took off.

NEW BACKSTOP TESTS ACCURACY OF PITCHERS

STRANGEST of devices to try out aspiring baseball pitchers is a novel target recently introduced in the East. Behind a dummy batter, who faces a home plate, is a backstop ruled in squares and charted with key letters. The pitcher under trial is required to try to hit any spot the instructor may order, with the various types of delivery at his command.

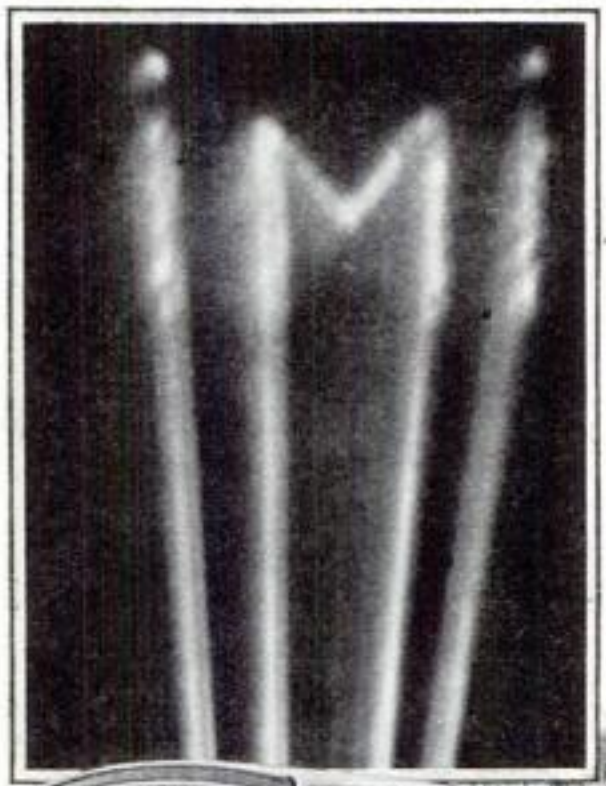
The instructor, meanwhile, keeps score of his success on a special sheet. Space is provided for noting the accuracy of his fast ball, and curve; also of his skill at delivering the ball overhand or underhand. From his hits and misses, his percentage can be recorded immediately in the last column of the score sheet and totaled at the end of the try-out. The device provides, perhaps for the first time, an exact numerical rating of a pitcher's ability. If he proves wild in his aim, only the dummy batter suffers.

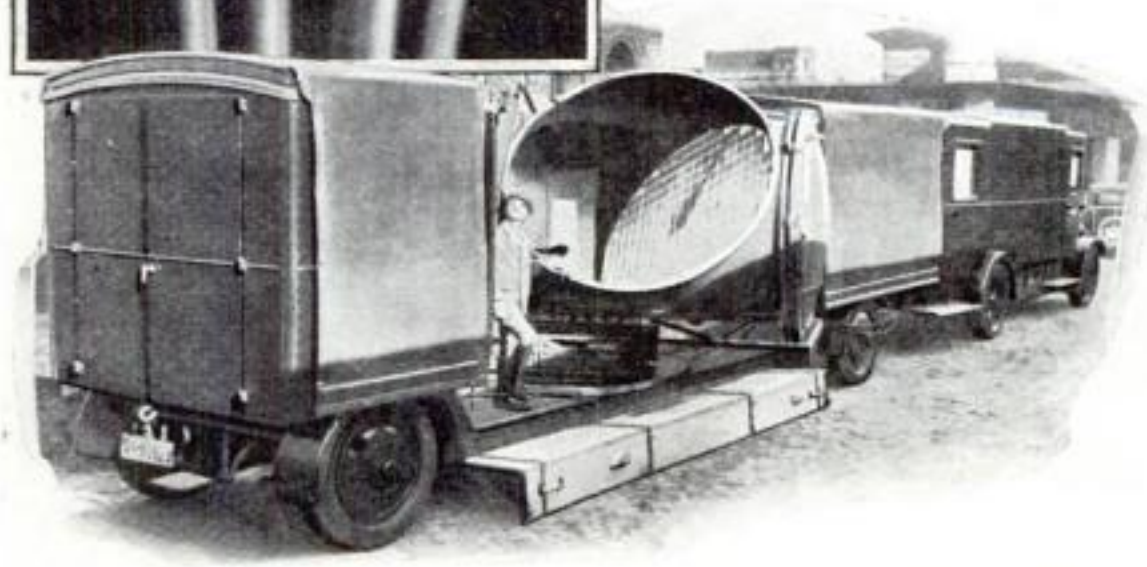
Baseball coaches expect that the device will prove especially valuable in checking and rating the ability of pitchers scouted in the minor leagues and who have had no chance to face big league batters.

GIANT LIGHT WRITES ADS ON CLOUDS

BERLIN crowds can now see advertisements projected on the clouds in the night sky, in letters a quarter of a mile high. Were they to follow the streamers of rays to their source, they would find a giant auto train occupying seventy feet of roadway. It comprises a billion-and-a-half-candlepower searchlight and a power plant to supply the enormous quantity of electricity it requires, all mounted upon automobile bodies.

Many experimenters here and abroad have developed experimental machines for "cloud-writing," but the German device is said to be the first to find actual commercial use. It writes its message effectively on clouds more than a mile above the earth, on the same principle as that used in the ordinary magic lantern or stereopticon.

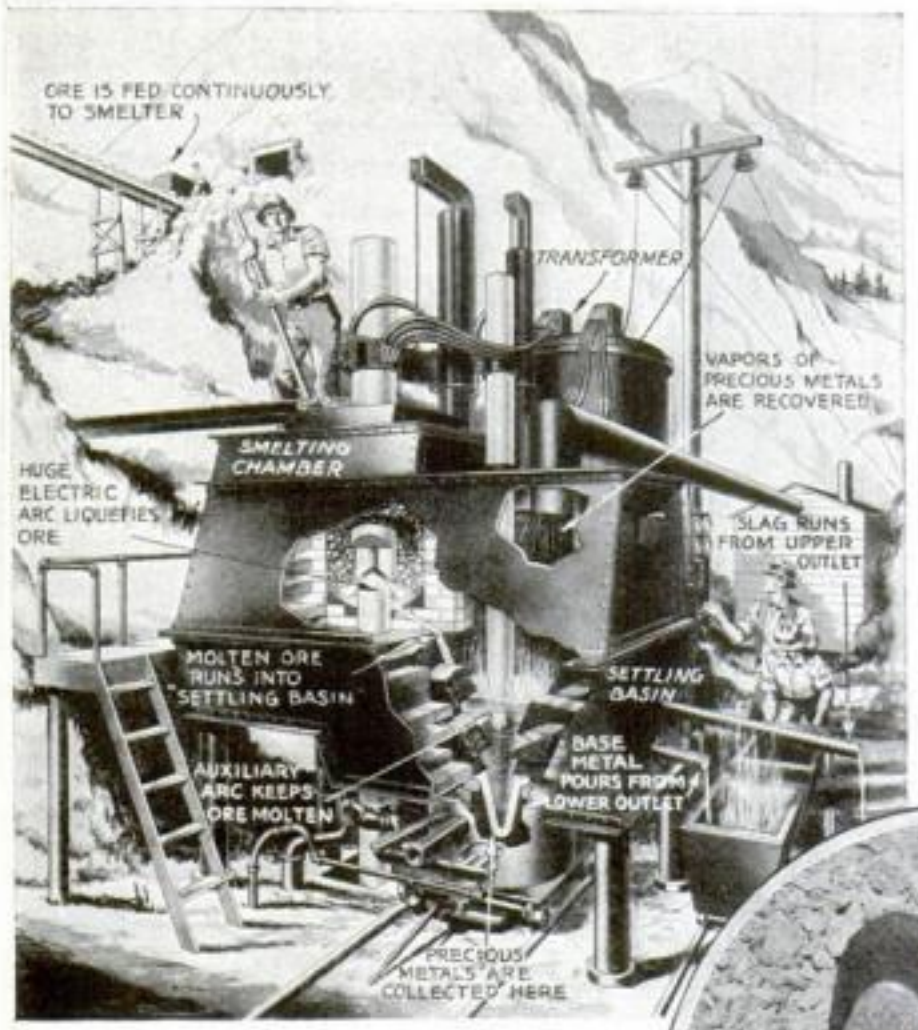




This auto train, seventy feet long, carries a gigantic billion-and-a-half-candlepower searchlight to paint signs on the clouds at night, as shown in upper left picture.

Ambitious baseball pitchers, throwing past the dummy batter at this target, are rated on their accuracy.

MIGHTY ELECTRIC ARC RECOVERS GOLD



Drawing shows how new smelter uses heat of big electric arc to recover metal from ore. At right, result of smelting ton of ore by new process.

AN ELECTRIC arc of more than 6,000 amperes recovers gold, silver, and base metals from ore in a new type of electric smelter invented in Oregon. Elbert Dyer, an inventor of Bandon, Ore., and Roland Sutherland, Alaskan miner, who visioned the new smelter, borrowed an electric transformer for their experiments. They planned a device that would melt ore shoveled into it, and maintain an unclogged arc. An experimental furnace at Portland handled ten to fifteen tons of ore a day.

GARDEN RAKE DESIGNED TO PREVENT CLOGGING

AN EXTRA sturdy dual-purpose rake that will not clog is a late invention of particular interest to the gardener. The rake thus combines the usefulness of the old-fashioned steel rake used for working in the soil with that of the Japanese bamboo rake for leaves and rubbish. It is made of pressed steel and is of much stronger construction than the ordinary type.

The shape of the new rake's flat teeth, which are considerably thicker near the rake head than at their lower ends and which also are round on the rear edge, is credited with giving the tool its non-clogging characteristic.

NEW ELECTRIC LAMP IS WATER-COOLED

Heat-absorbing liquid surrounds this new electric lamp so that the light it furnishes is kept cold.

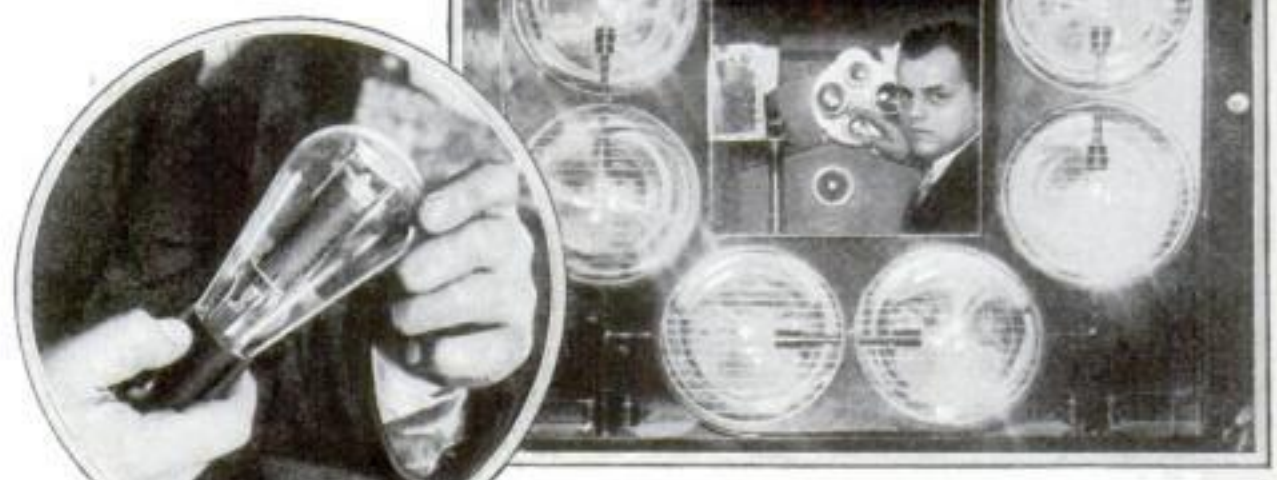
THOUGH the average electric lamp is far more efficient for heating than for illumination, the light from a new type of high-power lamp is cold. The new bulb is designed for uses where a minimum of heat is required, as over operating tables in hospitals, for lighting wax models in store window displays, and for projecting opaque objects in a stereopticon.

General Electric engineers designed a water-cooling system for the new bulb. It is surrounded by a bath of heat-absorbing liquid, a solution of copper salts. A cooling coil carries away the heat from this bath.

NEON ARC TUBE SHOWS BIG RADIO IMAGE

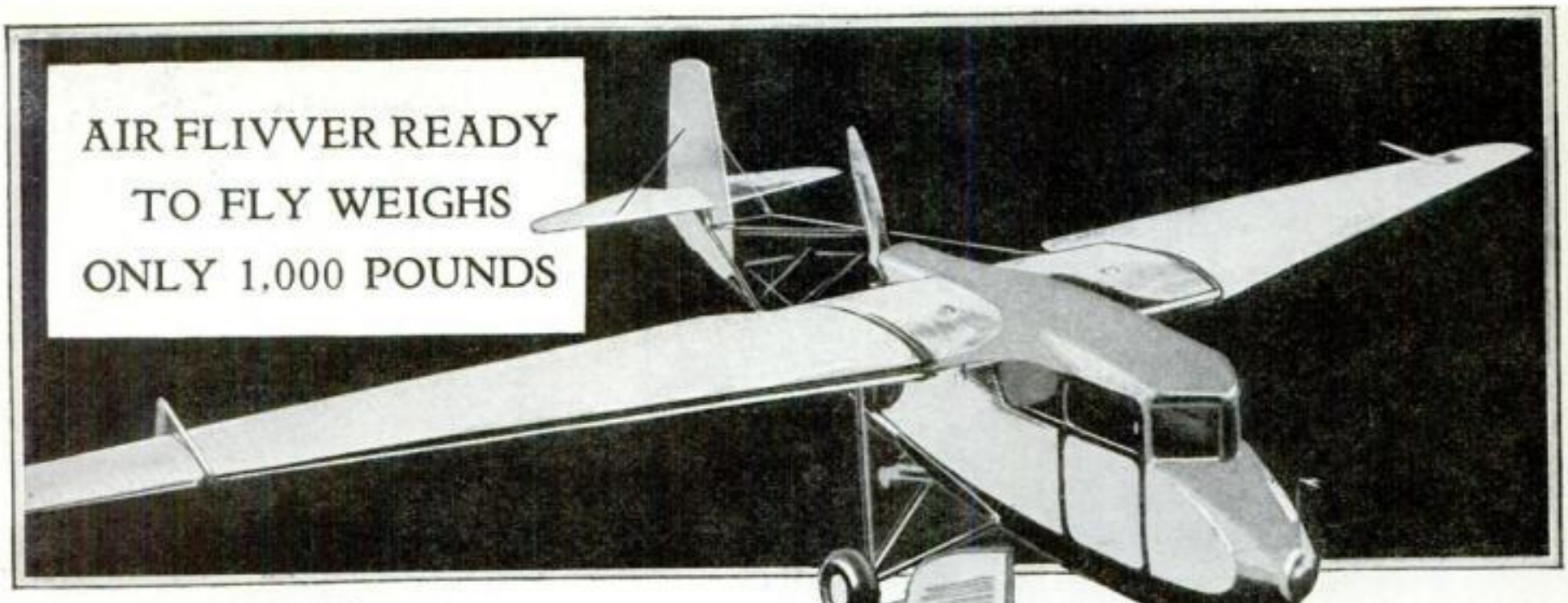
TELEVISION images appeared on a ten-foot screen the other day in the Chicago laboratory of U. A. Sanabria, twenty-four-year-old engineer. This is the largest television image yet shown on any screen. The secret of Sanabria's success is a new neon lamp capable of developing the amount of light needed to build up a television image of such large proportions.

The ordinary neon light used in small television outfits supplies too little illumination to cover a large screen. But with the invention by W. G. Taylor of the "neon arc" tube, used by Sanabria, the neon light becomes practical for making these large television images.



Using a new neon arc tube, recently invented, U. A. Sanabria, of Chicago, shown in photo, threw upon a screen the largest television image as yet successfully transmitted.

AIR FLIVVER READY TO FLY WEIGHS ONLY 1,000 POUNDS



Model of Henry Ford's new flivver of the air shows how the 1,000-pound plane will look as it is in flight. Its designer calls it the flying counterpart of the famous "Tin Lizzie."

At left, air flivver with wings removed showing how propeller is guarded. At right, William B. Stout, designer of the new plane.

REPORTS have long had it that Henry Ford, the man who made cheap automobiles popular, was about to produce a light plane that any man could afford to own and fly. Now Ford's chief aircraft designer, William B. Stout, announces what he calls "an aerial counterpart of the famous Tin Lizzie." This little two-seater plane was recently exhibited in Detroit. It was expected to be placed on the market soon, probably to sell at less than $2,000, and plans for quantity production have been made.

Within one of these novel all-metal planes, the driver of one of the first flivvers would feel right at home. A brake lever at the pilot's left, suggesting the emergency brake of early Ford cars, locks the plane's wheels while the motor warms up. Foot pedals like those on the old cars control the plane's lateral rudder. Even the ignition switch and the self-starter button are familiar to Ford drivers, but the dashboard has many dials not found in cars.

The plane weighs less than 1,000 pounds, and is said to be able to land in the space of a tennis court if necessary. It has a forty-three-foot wing spread. The seventy-five-horsepower motor drives a pusher propeller, carefully shielded by framework so that no one can blunder against it while the plane is on the ground.

"For the present," says its designer, "the plane is called the Sky Car, though the public, in its usual fashion, is likely to dub it something much less formal."

FLASHLIGHT IN CANE REVEALS KEYHOLE

FUMBLING for an elusive keyhole in the dark becomes a thing of the past, when this imported English novelty cane is carried. A slight twist of an ornamental band on the cane and a light flashes from the handle.

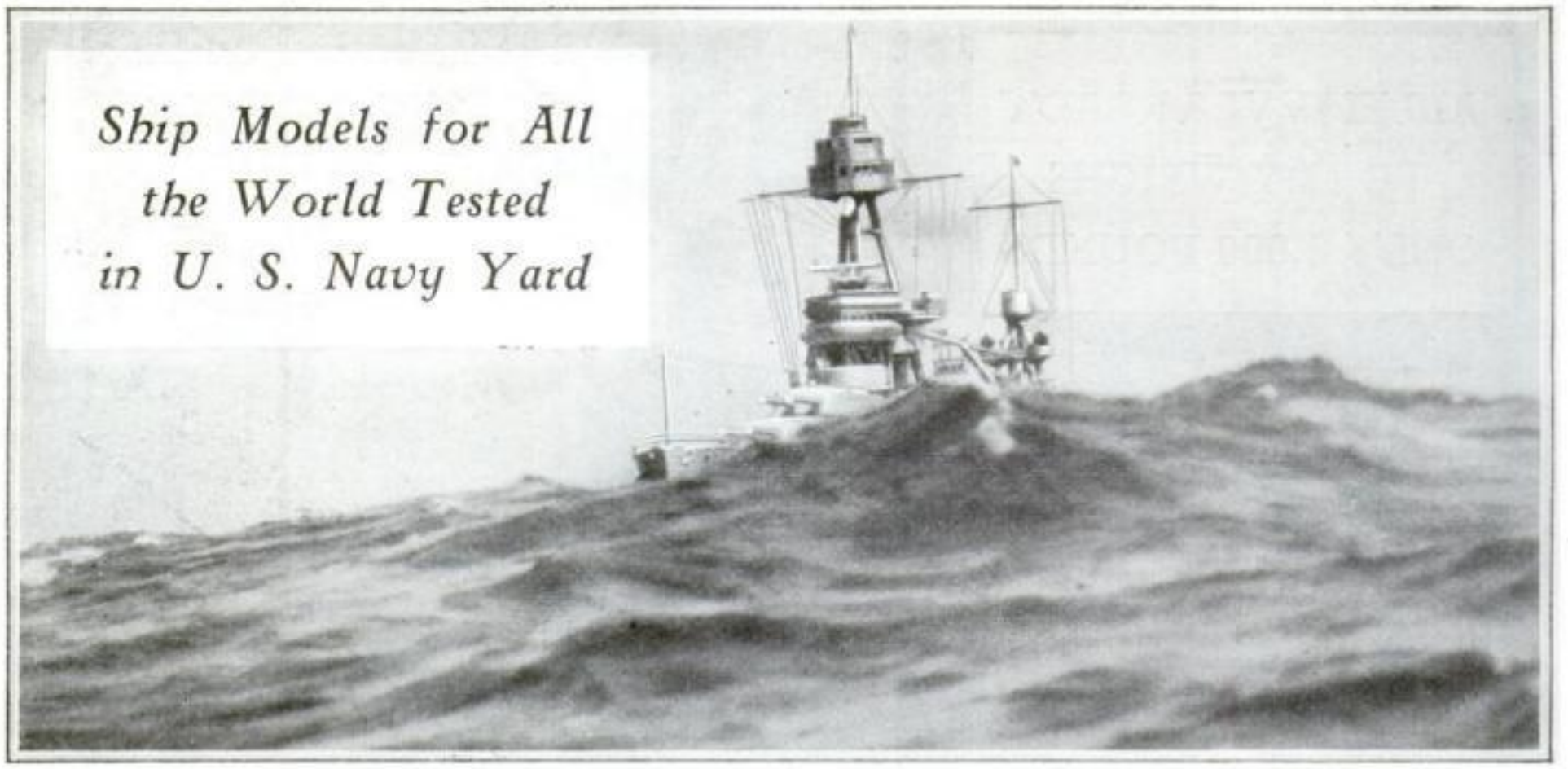
The secret is this: A slender battery is concealed in the hollow shaft and inside the white tip on the curved handle is a tiny flashlight globe. The device is simple but should prove convenient on a dark night to find the keyhole or look at a watch.

ROBOT ANSWERS PHONE AND TAKES MESSAGE

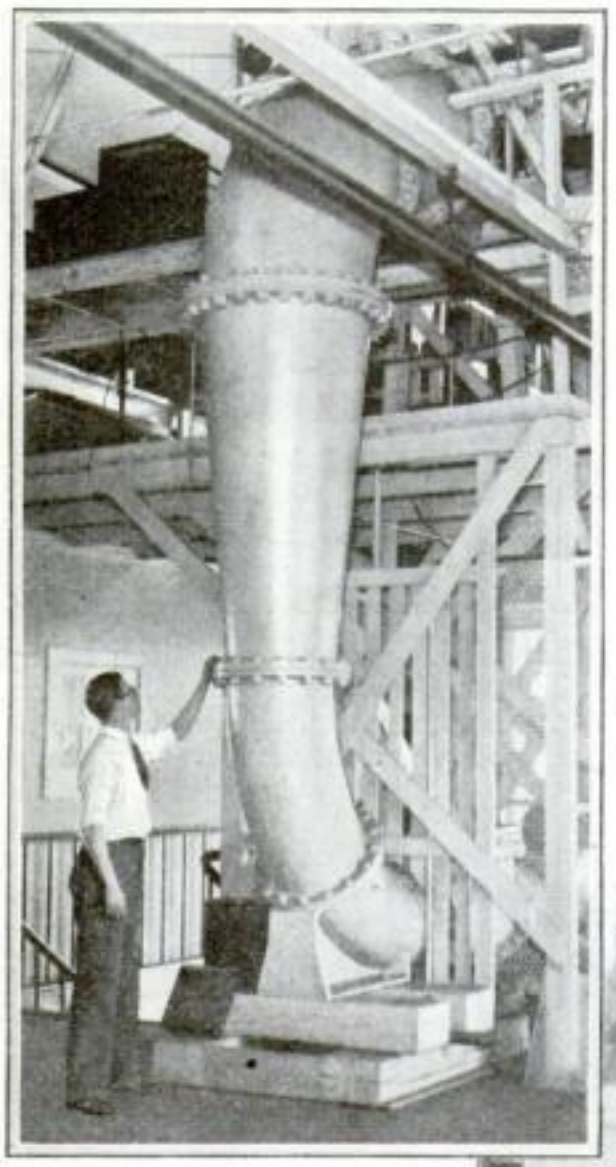
ONE of these days a telephone caller, having rung a friend, may get this answer: "Mr. Blank is not in. He will be here at eight this evening. If you care to repeat a message, Mr. Blank will receive it upon his return." An automatic device, invention of William Schergens, of St. Louis, Mo., answers the phone and takes a message. Whenever the telephone bell rings, the device answers. Then it waits for a reply.

When the phone rings this new invention will automatically answer and then record any message caller may wish to leave.

Ship Models for All the World Tested in U. S. Navy Yard



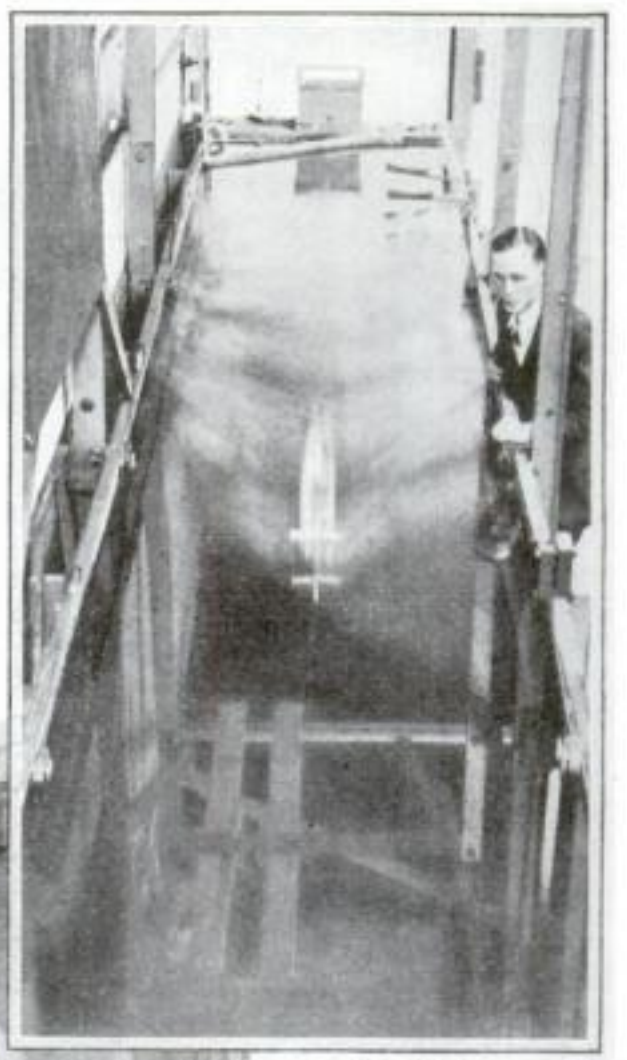
Pictures on this and the following page, here published for the first time, show how models of ships are tested in the United States Navy Yard and the right proportions and shape evolved to give the big, sea-going vessels, like the one above, the necessary buoyancy and power.



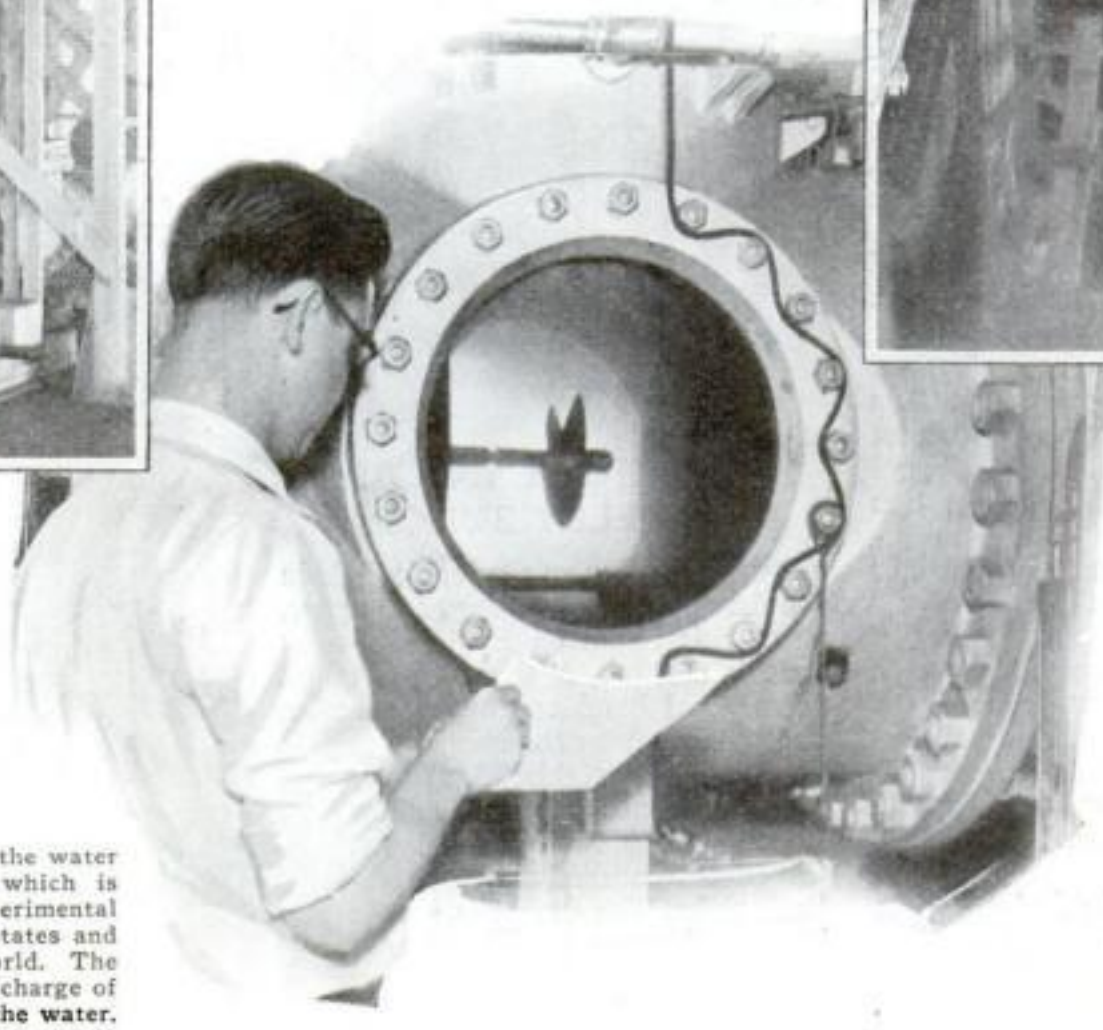
You may have wondered how the efficiency of a propeller for a big ship is tested and how the engineers know what it will do when put in actual use. This water propeller tunnel, built last year at the United States Navy Yard, is designed to answer just those questions. In it a propeller is studied much as a model plane is studied in the big wind tunnels.

TOWING toy-size boats in a tub is serious business at the Navy's model basin in the Washington, D. C., Navy Yard. The models reveal such things as resistance to water and required power of real ships similarly designed. Merits of propellers are also compared.

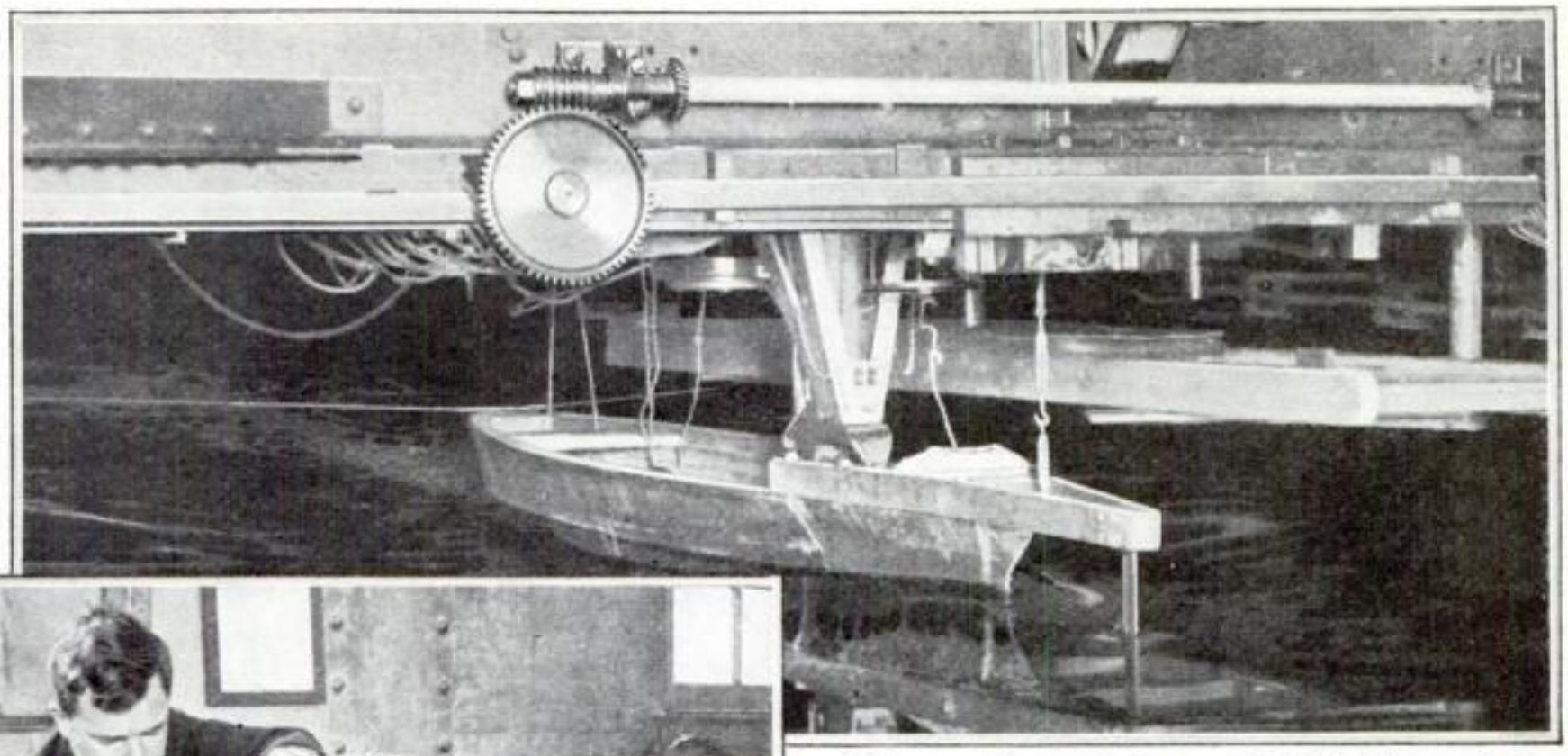
Practically every Navy vessel, even to the flat-bottomed, stern-wheel gunboats that paddle along Chinese rivers, is designed from models towed in this basin. Here was developed the bulbous bow, enlarged below the water line, of many of our warships. Adopted by the *Bremen* and *Europa*, it accounts for their speed. Merchant lines, ferryboat builders, and seaplane designers bring in models. A miniature of the cup winner *Enterprise* was tested before the yacht was built.



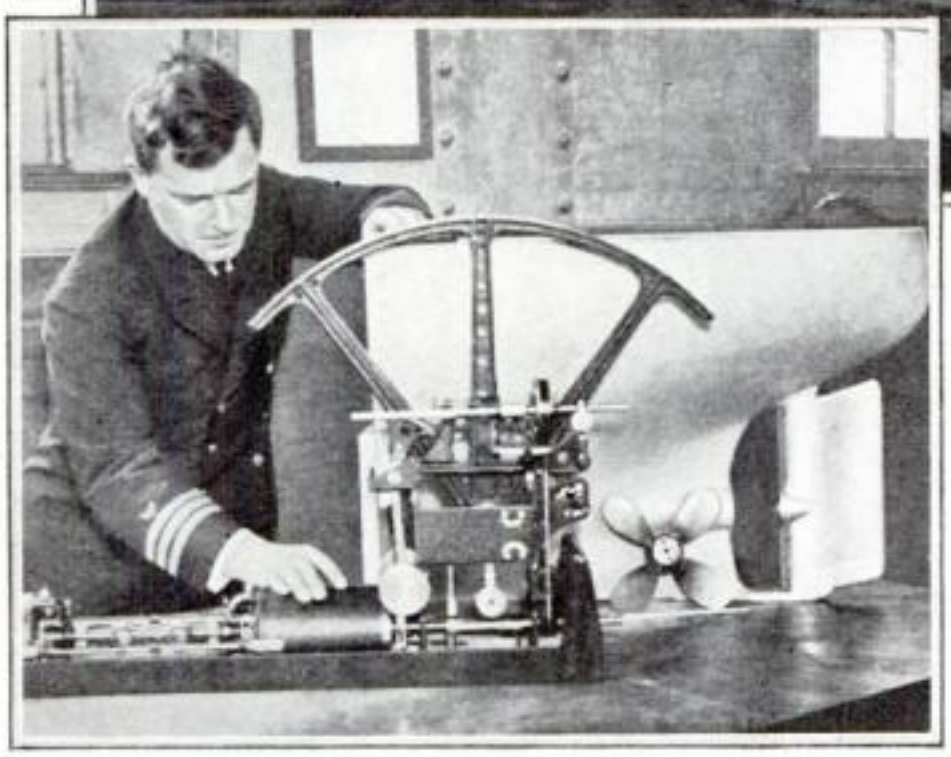
In this miniature model basin, the future form of mighty ships is determined. Small models are towed through this basin by weights at the rate of about two miles an hour. As they move slowly along, W. H. Powers, junior physicist in charge of the small basin, observes the wave profiles thrown off by the hull of the tiny craft. These wave outlines are charted and from them is calculated the most serviceable hull shapes. In this way designs for use in all parts of the world, from America to China, are now being scientifically perfected.



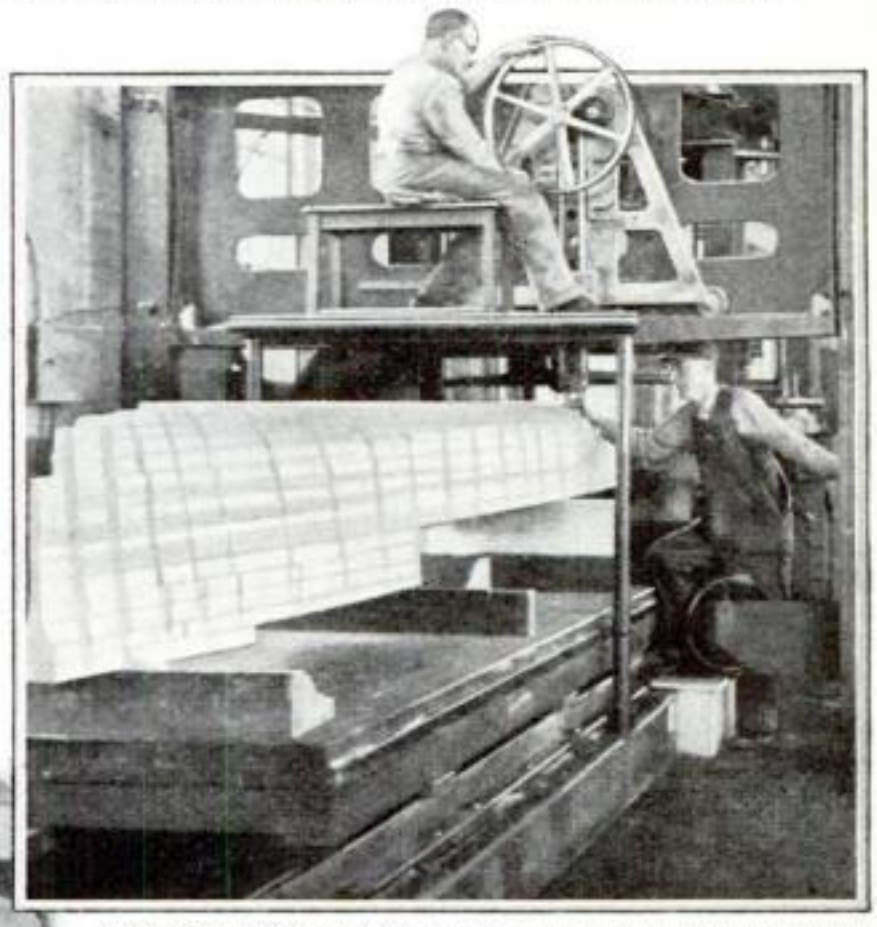
At the right, you are looking into the water propeller tunnel, the outside of which is shown above. This is the only experimental tunnel of the kind in the United States and there is only one other in the world. The propeller, which W. L. Peverill, in charge of the tunnel, is examining, rests in the water.



Here a propeller, attached to a model hull, is being tested. In the boat are two dynamometers which make a mechanical record of the propeller's torque and thrust at seven-mile speed.



Commander Saunders, of the Navy Yard, is inspecting a dynamometer, an instrument for determining torque and thrust of a propeller. Arc records thrust.



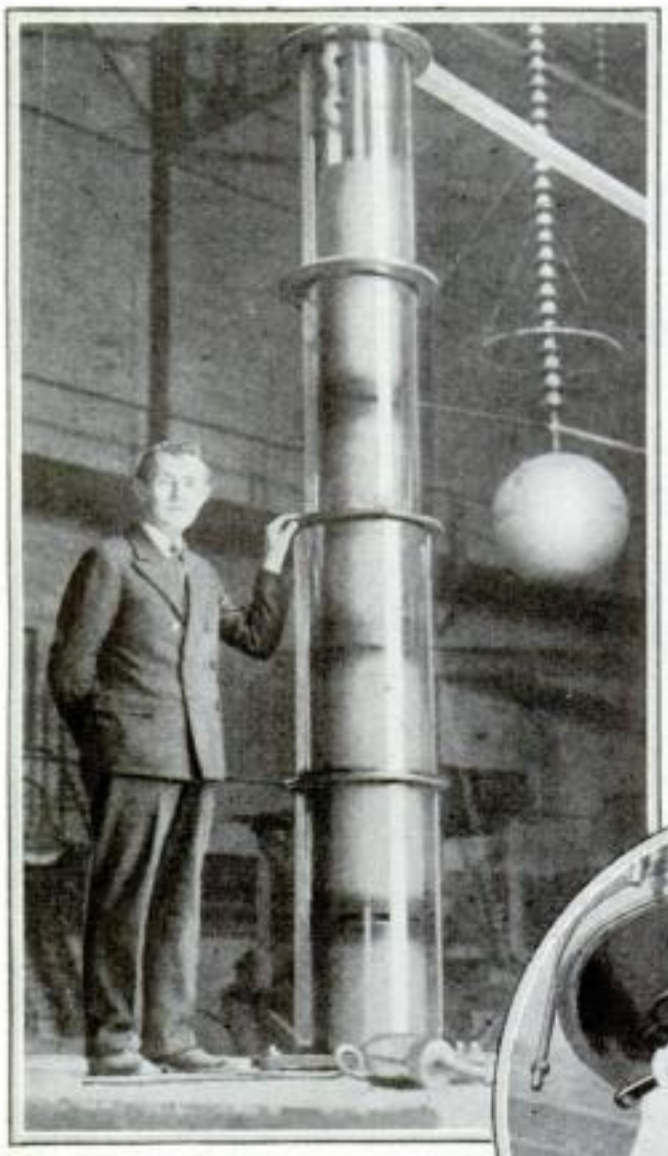
With this model-roughing machine hull models are cut down to the desired size after they have been built up with glued strips. Revolving cutters, guided by templates, rough this new destroyer model and afterwards it will be hand finished.

This hull model, which has just left the roughing machine, is being hand finished before going into the basin for test.

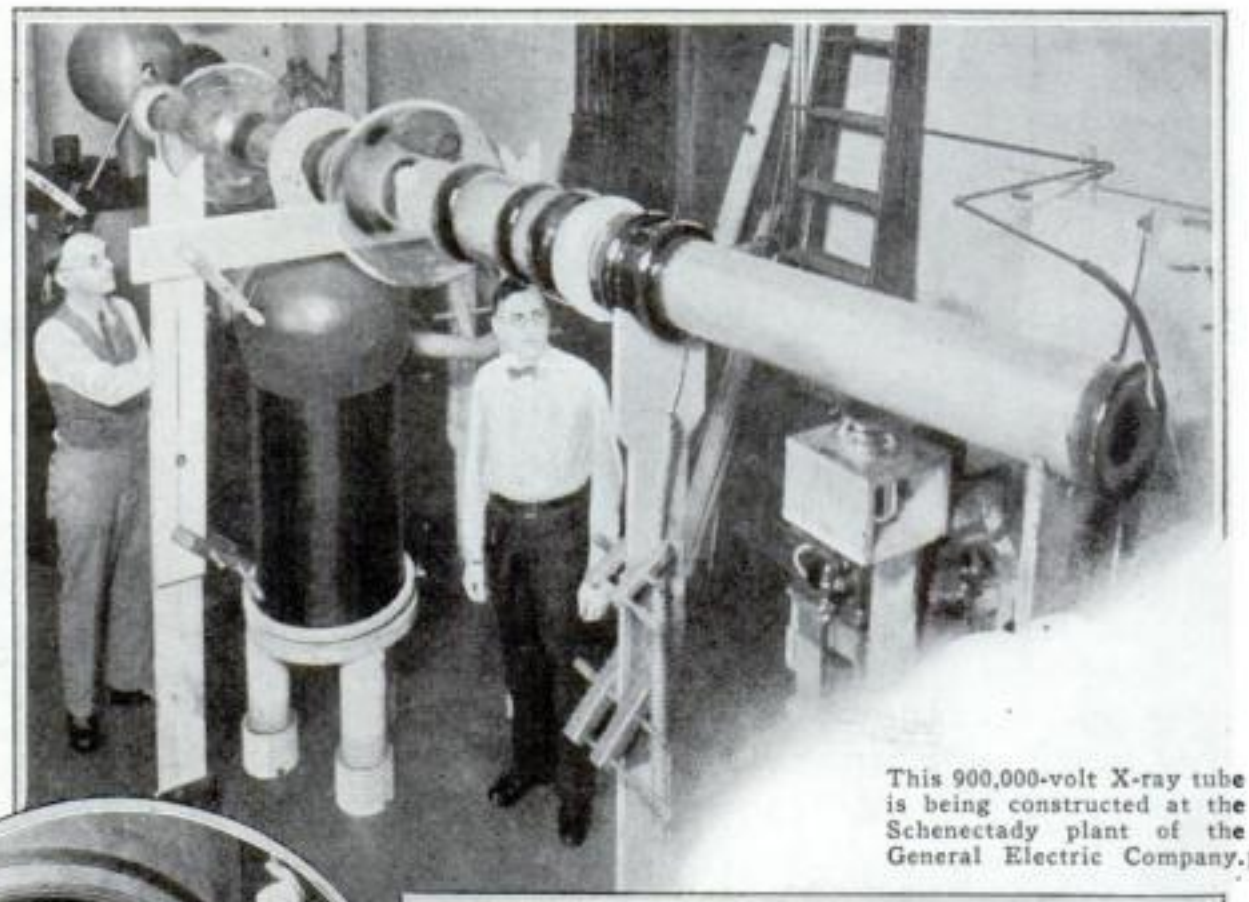
J. H. Curry, design draftsman at the model basin, is studying a hull model of the gigantic long range seaplanes now being built for the United States Coast Guard. Many models of these great hulls were tested under varying conditions before they were approved by the Coast Guard officials.

Nothing is left to chance or the frailty of human powers. As the model under test cuts through the water of the basin, the instrument board and recording stand, shown here, make a permanent record of its reactions at a steadily maintained rate of speed.

Gigantic X-Ray Tubes Designed for War on Cancer



This great X-ray tube, which uses a power of 600,000 volts, is being built at the California Institute of Technology. It was designed by Robert Millikan and Charles Lauristen.



This 900,000-volt X-ray tube is being constructed at the Schenectady plant of the General Electric Company.

From this end of the mighty tube will issue the rays, similar to the gamma rays of radium, that will be used in treating cases of cancer. In the photo, Dr. Lauristen is seen at work on the tube.

This posed photograph shows how the gigantic X-ray tube will be used, when completed, in administering treatment.

Two huge X-ray tubes, one at the California Institute of Technology, Pasadena, Calif., and the other by the General Electric Company, at Schenectady, N. Y., are now being constructed. Dr. Robert A. Millikan and Professor Charles Lauristen designed the apparatus under construction at Pasadena.

Its design is based on six months of experimental work with a similar instrument at present in use at the California Institute of Technology. Although it has been planned to use a power of 600,000 volts on this tube, in an emergency its power can be increased to 1,000,000 volts.

The tube being built at Schenectady was designed by Dr. W. D. Coolidge of the General Electric Company's staff, and when completed will be installed in the Memorial Hospital, New York City. It has a power of 900,000 volts.

These titanic instruments will be used in science's war against cancer. They will produce rays comparable to radium's gamma rays, which cannot be produced with low power X-rays.

MAY REDUCE HUMIDITY

Soon to be placed on the market, according to advance reports, is a novel apparatus that will make the air in sleeping and living rooms less humid during summer months. Exactly opposite in principle from standard air moisteners, this de-humidifier will draw moisture from the air. Details concerning its operation have not yet been made public.

PLANES TO FIGHT FIRES, FAMED CHIEF PREDICTS

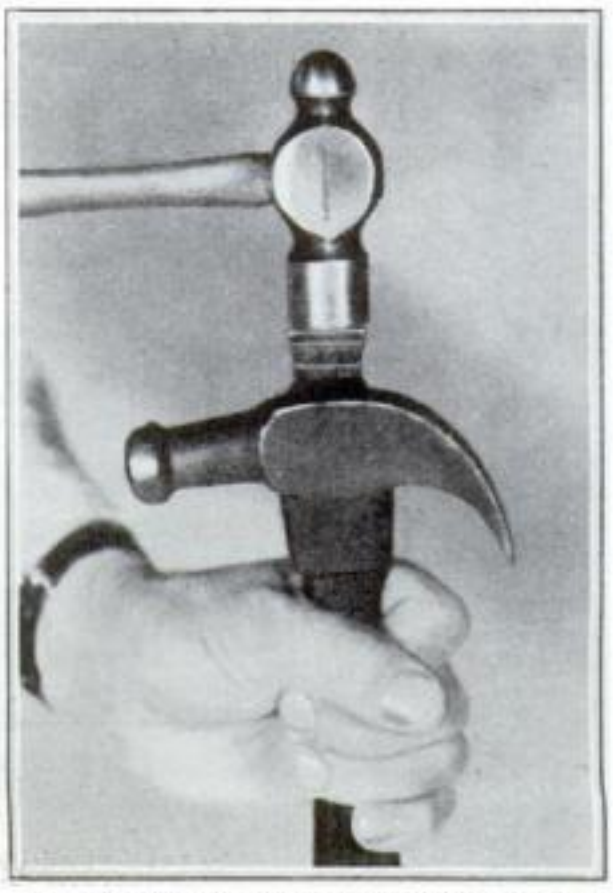
A veteran fire-fighter, John Kenlon, who recently resigned as Chief of New York City's Fire Department after nearly twenty years at that post, predicts revolutionary changes in fire fighting.

One of these days, he foresees, airplanes will supersede automobile fire engines. They will hover stationary over burning buildings and smother the fire with clouds of powerful gases.

"Such gases may not yet be known, but they will be discovered," Kenlon says. "Perhaps twenty or forty years from now no fire engines will congest traffic. All fire fighting will be clear of the streets."

HOLDS HAMMER HANDLE

Loose hammer handles, caused by wedges working out, may be avoided by using a wedge recently placed on the market. A series of projections cause it to bite into the wood of tool handles, holding itself firmly in place.



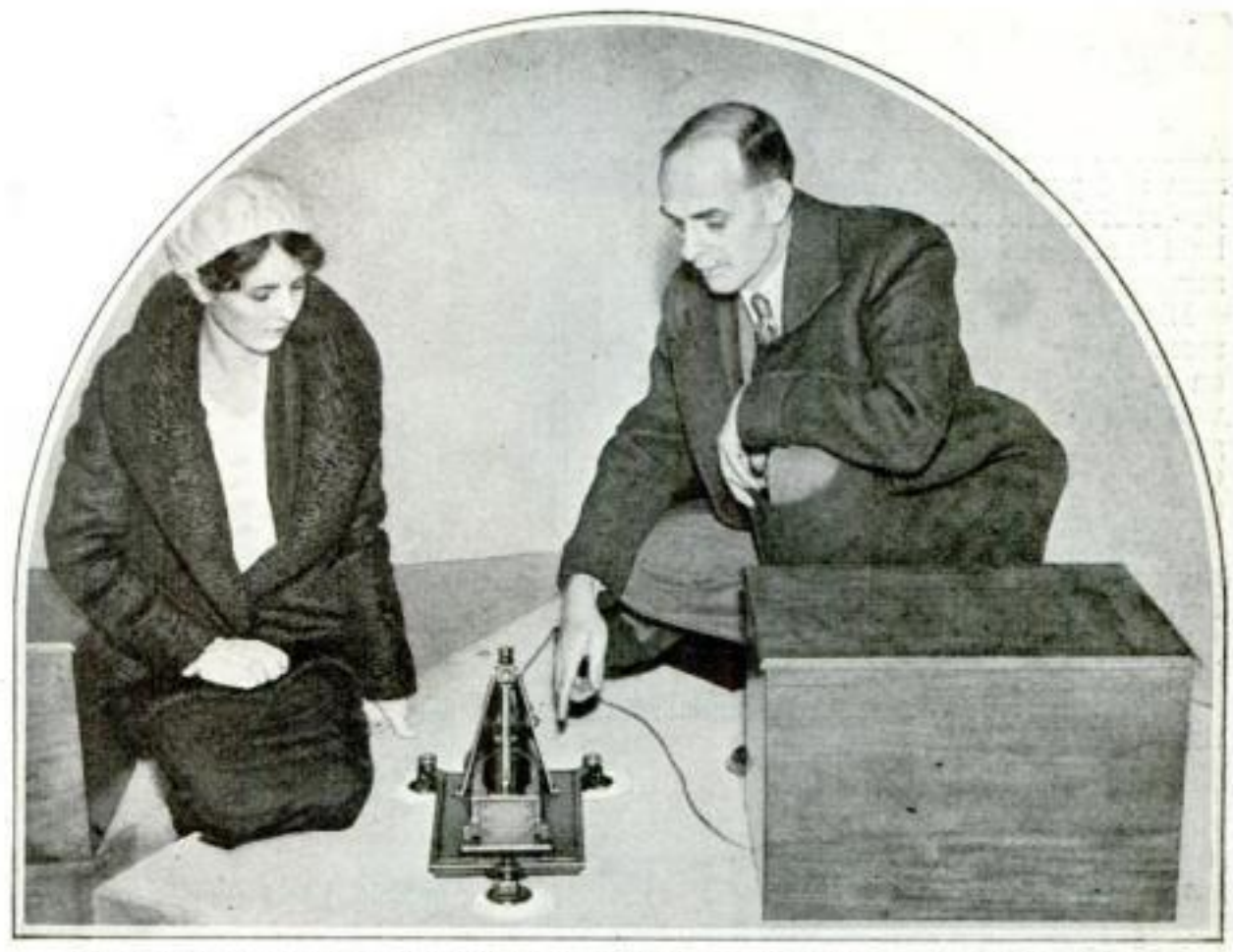
A new wedge, that locks itself in with a series of projections, holds hammer handle tight.

NONFADE WALL PAPER PROVED BY TEST

Two years of sunlight were crowded into a few hours in New York recently when a new wall paper was given a fading test by artificial sunshine. Samples of the paper were stretched over small openings at the base of a large cylinder. Rays from a powerful sun lamp, which was installed within the cylinder, fell on them through the openings.

For twenty-four hours the lamp's powerful rays shone on the new paper, a length of time estimated to be equal to two years of sun exposure on the walls of an average room. No fading of the new paper was noticed after its severe test. Light was made to fall on it through small openings so fading, if any occurred, would be noticeable by comparison with the portions of the samples not receiving the rays.

New wall paper, shown above, did not fade under rays duplicating two years' sunlight.



The tiny instrument in the photograph above is a new seismograph that has recently been installed in one of the University of Pittsburgh buildings to study small earth movements.

NEW SEISMOGRAPH PUT IN USE AT PITTSBURGH

STRIKING in contrast to the bulk of ordinary seismographs, or earthquake detectors, is the diminutive size of a new instrument recently installed at the University of Pittsburgh. It is called the only one of its kind in the Western Hemisphere. Earth quivers detected by its tiny arm are magnified electrically, and recorded on smoked paper in a near-by cabinet.

HIGH PITCHED SOUNDS KILL HUMAN CELLS

IF THE squeak of a rusty door hinge, or of a piece of chalk upon a blackboard, sets your nerves on edge, perhaps there's a reason. When loud and high pitched enough, it is actually deadly to cells and small organisms, investigators have found.

Both germs and the red corpuscles of human blood were killed by audible noises, in tests conducted by Prof. O. B. Williams, University of Texas bacteriologist, and Prof. Newton Gaines, Texas Christian University physicist.

They put the germs in a flask and set the vessel in a tank of water. Agitating the water was a nickel tube, vibrated by electromagnets about 8,800 times a second. It produced sound waves so intense as to be best described as a terrific squeak.

Germs thus "rayed" for periods of from ten minutes to an hour suffered high mortality, less than half remaining alive after the longest period. Other experimenters have killed living things with sound waves so high pitched as to be inaudible, but this is the first time that waves the human ear can hear have proved deadly.

MATHEMATICS MAY BRING NEW MUSIC

A METHOD of dividing the musical scale, which may result in new and strange harmonies, was demonstrated in New York City recently by Augusto Novaro, a Mexican of Italian descent. Twenty years of experiments were required to perfect the system, which is based on mathematical calculations and instruments of Novaro's design.

Musical experts before whom it was demonstrated felt that it might possibly revolutionize present laws of musical composition. One of the experimental instruments used in developing the system was displayed by Novaro. It consisted of a rectangular sounding box, across which a series of strings were stretched. Between the strings across the top of the box was a scale upon which divisions were marked. To demonstrate his theory Novaro, who is only forty years of age, has designed in the past twenty years several other precision instruments besides the one shown in the photograph below.

Augusto Novaro demonstrates his new division of musical scale.

CURVED FILE GIVES NAILS RIGHT SHAPE

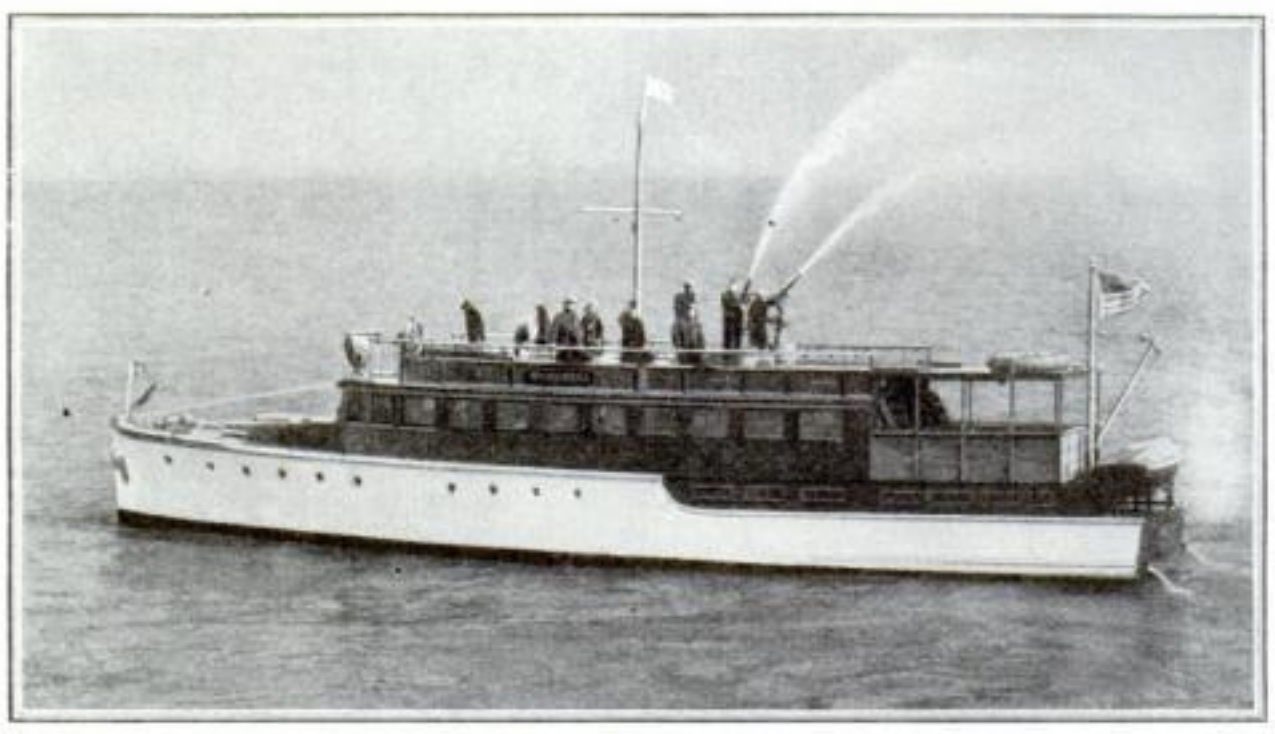
A CURVED, trough-shaped nail file placed on the market recently is a useful manicuring tool. Rubbing it across the nail ends, which are held inside its trough, results in nails filed to shape. This novel instrument is made with three sections—one especially for the thumb, one for the little finger, and one for the three middle fingers. At its end is a nail cleaner and cuticle pusher.

PRIVATE YACHT IS ALSO FIRE FIGHTING BOAT

BECAUSE his hobby was fire fighting, Albert T. Bell, Atlantic City, N. J., hotel man and president of the National Fire Protection Association, had a private yacht built for himself that could be pressed into service to fight waterfront fires.

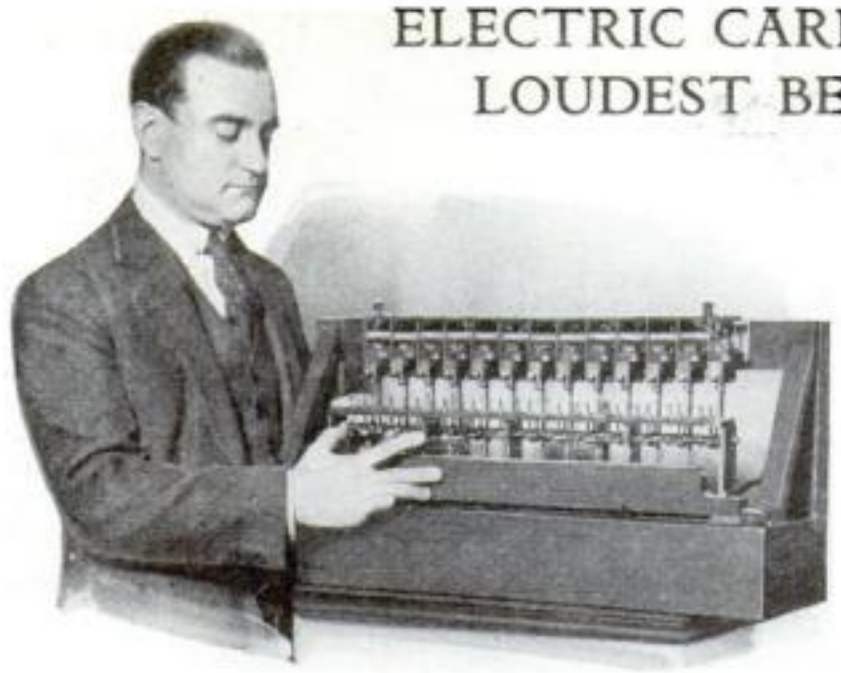
Electrically-driven pumps in her engine room supply water to powerful fire nozzles on top of the deck house, enabling the vessel to aid local fire fighters in an emergency. The yacht herself is fireproof. Cooking and heating are done by electricity. Since the electricity is generated by Diesel engines, which also drive the boat, there is less risk in taking her near burning craft than if she used gasoline.

Another novelty in the yacht is the heating system. Hot water, heated by electricity, is stored in a tank and circulated through her radiators as required.



This is a pleasure yacht or a fire boat by turns and was designed for Albert T. Bell, president of the National Fire Protection Association, to serve in both capacities.

ELECTRIC CARILLON PLAYS LOUDEST BELL NOTES



Faint bell notes produced by this electric carillon are amplified by vacuum tubes until they are loudest ever heard.

BELL notes louder than any ever heard by human ears can be played by a small electric carillon, not much larger than the average radio set. The apparatus, recently developed by a New York City manufacturing firm, also can reproduce bell sounds as faintly as the ticking of a tiny boudoir clock. A series of little chimes are struck by small electric hammers actuated by a keyboard.

Although sounds made by the small chimes are so faint they can be heard only a few inches away, their vibrations are picked up and amplified millions of times by vacuum tube amplifiers. They then are played out into an audience or from a church tower by giant loudspeakers. By simple manipulations of the keyboard, a player can render sounds barely inaudible or swell them into a roaring tumult of harmony. A similar device is used to broadcast chimes from the City Hall of Camden, N. J. (see page sixty-eight).

VARNISH HAS NO ODOR

A NEW odorless varnish that can be used in refrigerators without harm to foods was announced in a recent report to the American Chemical Society. Varnishes at present in use contain a strong-smelling material known as phenol which is easily absorbed by fatty foods like butter. The odorless varnish is expected to reduce construction cost of refrigerators.

SLEEP WHILE YOU RIDE WITH NEW HEAD REST

SO THAT motorists may travel in comfort, sleeping while riding if they desire, M. A. Montenegro, of Tampa, Fla., has devised a head rest for use in autos. Straps suspend the rest from crosspieces in a car's top. The device is equipped with "ear flaps" to prevent the noise of travel disturbing the sleeper.

Shocks and jars of rough roads are eliminated by its elasticity. A head rest for every passenger may be fitted in any car with a top. They are expected to prove a convenience for bus passengers and motor tourists on long runs.

DIAL GIVES REMOTE RADIO CONTROL

A CAMDEN, N. J., manufacturer has just introduced a remotely controlled radio set that uses the standard type of phone dial. The rotating dial is set on a case no larger than that of a small traveling clock. It is operated by the finger or the end of a pencil.

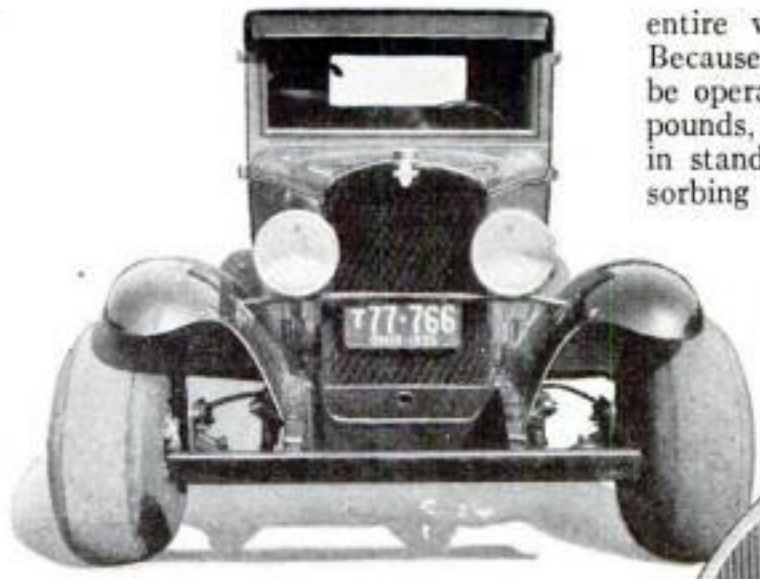
Simple number combinations like ordinary telephone numbers can be used to "call" any one of the eighteen desired stations and to regulate volume. The device also can control phonograph record playing equipment. By dialing the proper number, it is possible to start or stop the phonograph.

Strongly resembling an ordinary telephone dial, the device shown above and at left is a remote control for radio set. It can "get" any one of eighteen stations.

NEW STYLE DEVISED FOR TIME BY TELEPHONE

SO MANY phone subscribers desire the correct time at a nominal charge, a service provided in several cities, that a new system will soon enable one operator to give many callers the time at once. Pictured above, she announces thus, "When you hear the tone signal it will be exactly 10:45½ A.M." The musical note sounds every quarter minute. A flashing green light tells the operator when to start announcing. If a white light shows no subscribers are on the line and she may stop announcing and save her voice.

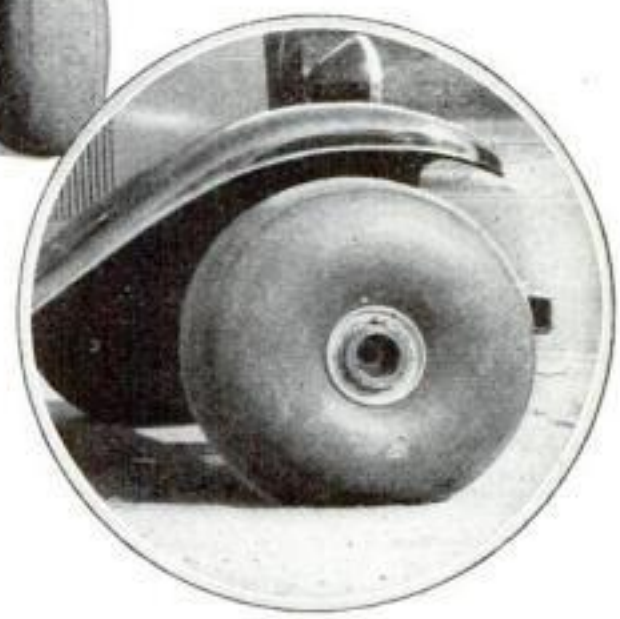
BALLOON WHEELS DEVELOPED FOR AUTOS



An Ohio inventor has adapted to his car this first set of balloon wheels ever built for autos.

PLEASURE cars and light motor trucks may soon roll more smoothly on "balloon wheels." Recently an Ohio inventor succeeded in adapting a set of these extraordinary devices, previously used only on airplane landing gear, to replace the conventional wheels and tires of an automobile. He fitted a set to a test car and drove it day and night for more than 20,000 miles to prove that they would stand up well in service on the highway.

With the exception of the hub, the entire wheel is a huge pneumatic tire. Because of its great air capacity, it may be operated at air pressure as low as ten pounds, or about a third the pressure used in standard balloon tires. The shock-absorbing quality of the balloon wheels, according to the inventor, may eliminate the need for springs in cars of the future. He plans to equip a springless car with the wheels to test this possibility.

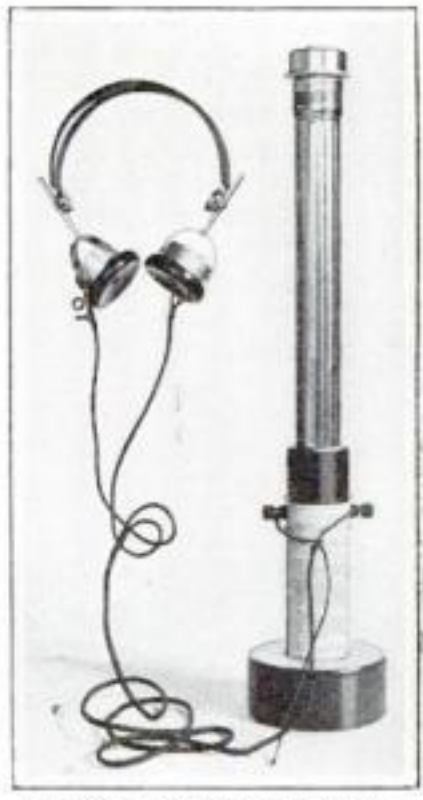


This side view of the balloon wheel shows how it consists exclusively of tire and hub.

WORLD'S COSTLIEST CAR SET WITH DIAMONDS

A DIAMOND studded automobile, the most expensive in the world, costing $125,000, was displayed recently at Kansas City, Mo. It was built to commemorate the silver jubilee of a dealer's organization, and is finished largely in silver.

To maintain the car requires the presence of a large armed guard to protect its silver, jewels, and fine machinery. More than $100,000 worth of precious stones, chiefly diamonds, adorn its hub caps, instrument board, and controls.

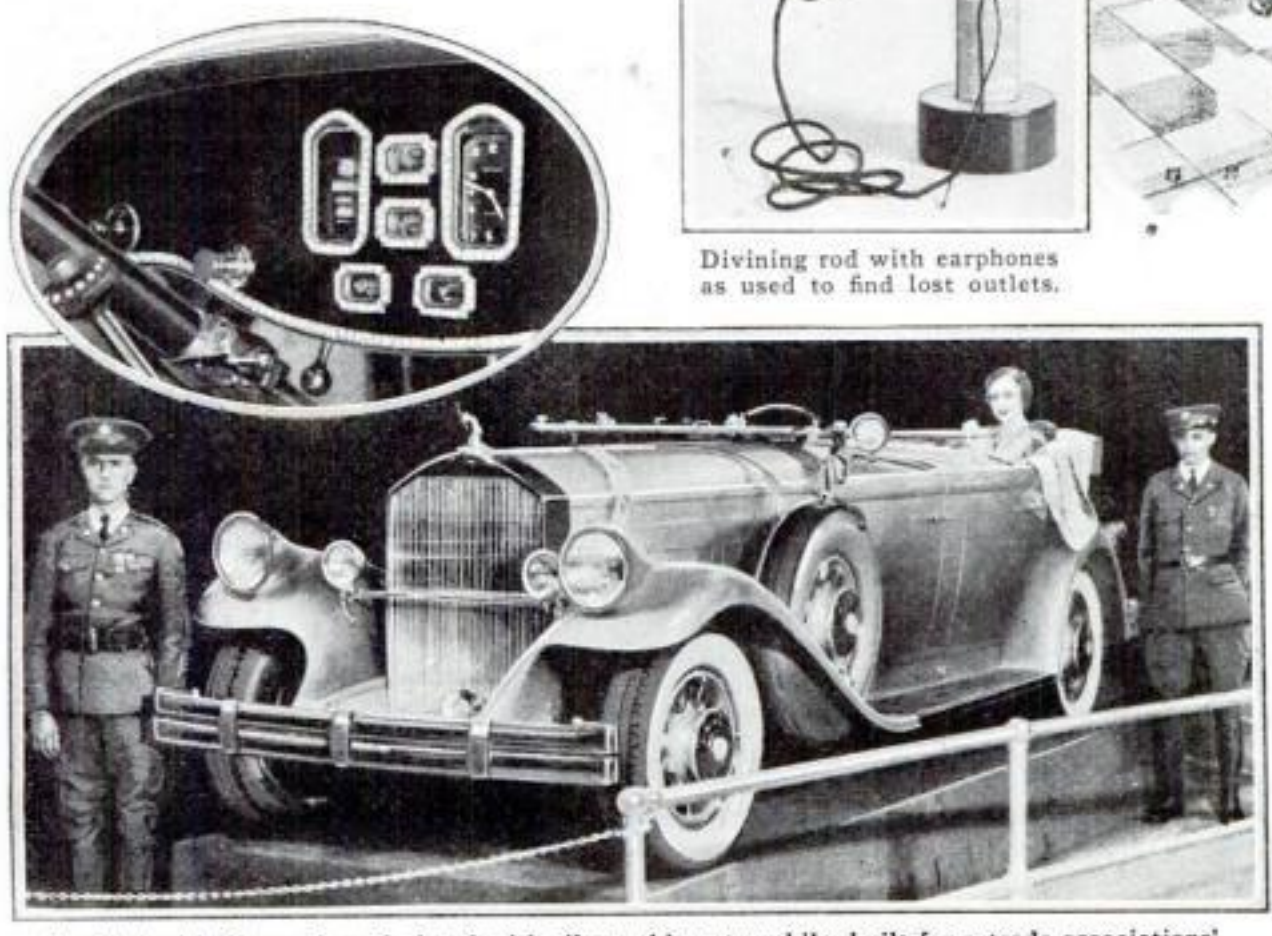


Divining rod with earphones as used to find lost outlets.

DIVINING ROD FINDS LOST WIRE OUTLETS

BORROWING an idea from prospectors, engineers of a Pittsburgh, Pa., manufacturing firm have perfected an electric "divining rod" for locating hidden electrical outlets in floors. As changes are made in the arrangement of factories or offices, wiring connections for desk telephones, lights, or buzzers are sometimes covered with linoleum. Frequently it becomes necessary to use such connections for rearrangements of equipment.

Using the divining rod to trace the metal conduits carrying the wires, the connections are easily found. Placing a telephone head set, connected to the device, over his ears, a user carries the rod over the floor. As it nears a metal object such as a conduit a buzzing sound is heard, while a different buzzing occurs as it passes over outlets in the conduit.

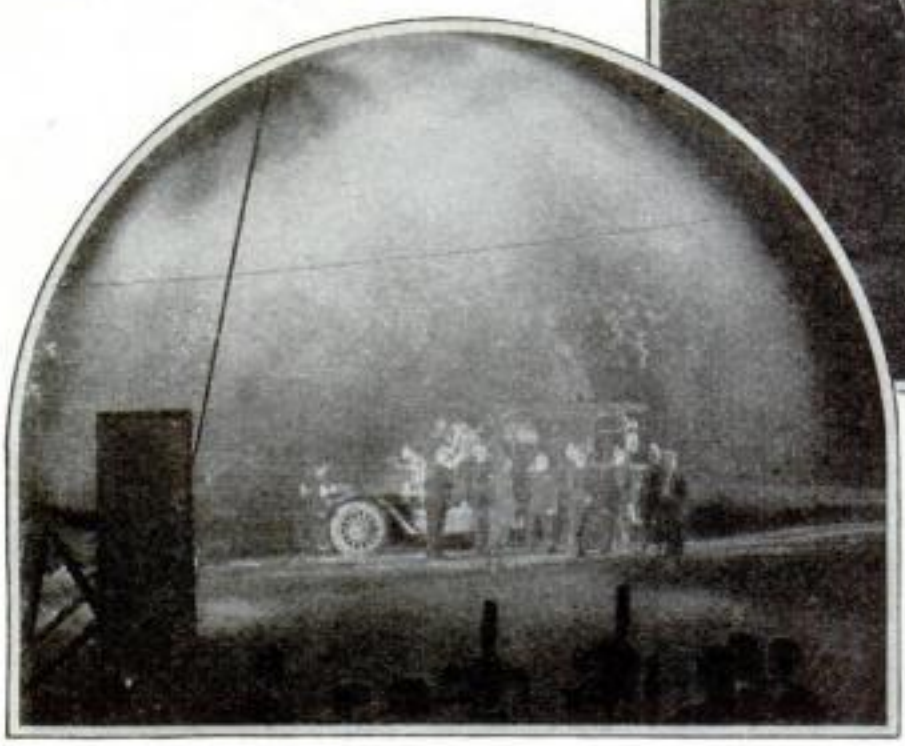


Studded with diamonds and plated with silver, this automobile, built for a trade associations' silver jubilee and costing $125,000, was exhibited recently as the world's highest priced car.

New Film Gives "Night" to Movie

Supersensitive camera and high powered incandescent lamps add realism to work in pictures—Mineral oil sprayed by giant atomizer gives appearance of fog thick or thin as desired

This "real" fog for a movie scene was made with mineral oil vaporized by big atomizers and blown by airplane propellers. Thus any fog density is made.



A movie night scene shot during an artificial rainstorm. Water, hurled out at the top of umbrella sprinkler, is rain.

ONCE, when it became necessary to shoot a movie scene supposed to take place at night, the actors went through their stuff in broad daylight. Then the film was dyed blue to give the night effect. The result often required a bit of imagination on the part of the audience, especially when the sky was brighter than it could be with the brightest moon you ever saw.

Now science has made it possible to take movie night scenes that are realistic down to the last detail. Simulating rain, fog, darkness of any degree, and the other conditions of night is easy for the modern movie producer.

Perhaps the most novel of the newer effects is fog. Instead of the chemical fogs once used, movie producers now use hundreds of gallons of the ordinary tasteless mineral oil. By the aid of giant compressors that work like the perfume atomizer, this mineral oil is turned into a fine mist that hangs in the air for hours and yet does no damage to scenery or costumes. Every degree of fog from the London "pea soup" variety down to vague mists for dock and river scenes can be made by these machines.

Two new developments have made real night scenes more practical. One is the invention of movie film that is enormously sensitive to artificial light such as that given by incandescent lamps. The other is the production of incandescent lamps of huge power.

One of the most ambitious night scenes ever filmed was recently recorded. A street 1,200 feet long and full of people was lighted by "inkies," the studio name for powerful incandescent lights. The directing of this scene was so difficult that a squad of electricians equipped with earphones was scattered through the crowd to take care of orders for changing of lights. Such a scene would have been almost physically impossible under old-fashioned conditions with plain film. All the lights in Hollywood wouldn't have given enough illumination.

Cameras, beam microphone, and lights here are mounted on a traveling parallel to record a night scene.

ASIDE from making ordinary night scenes mere child's play, the new lights, new film, and new fog making apparatus revolutionize the realism of scenes of a more difficult nature. Flood scenes, for example, are made far more natural by adding driving rain and fog.

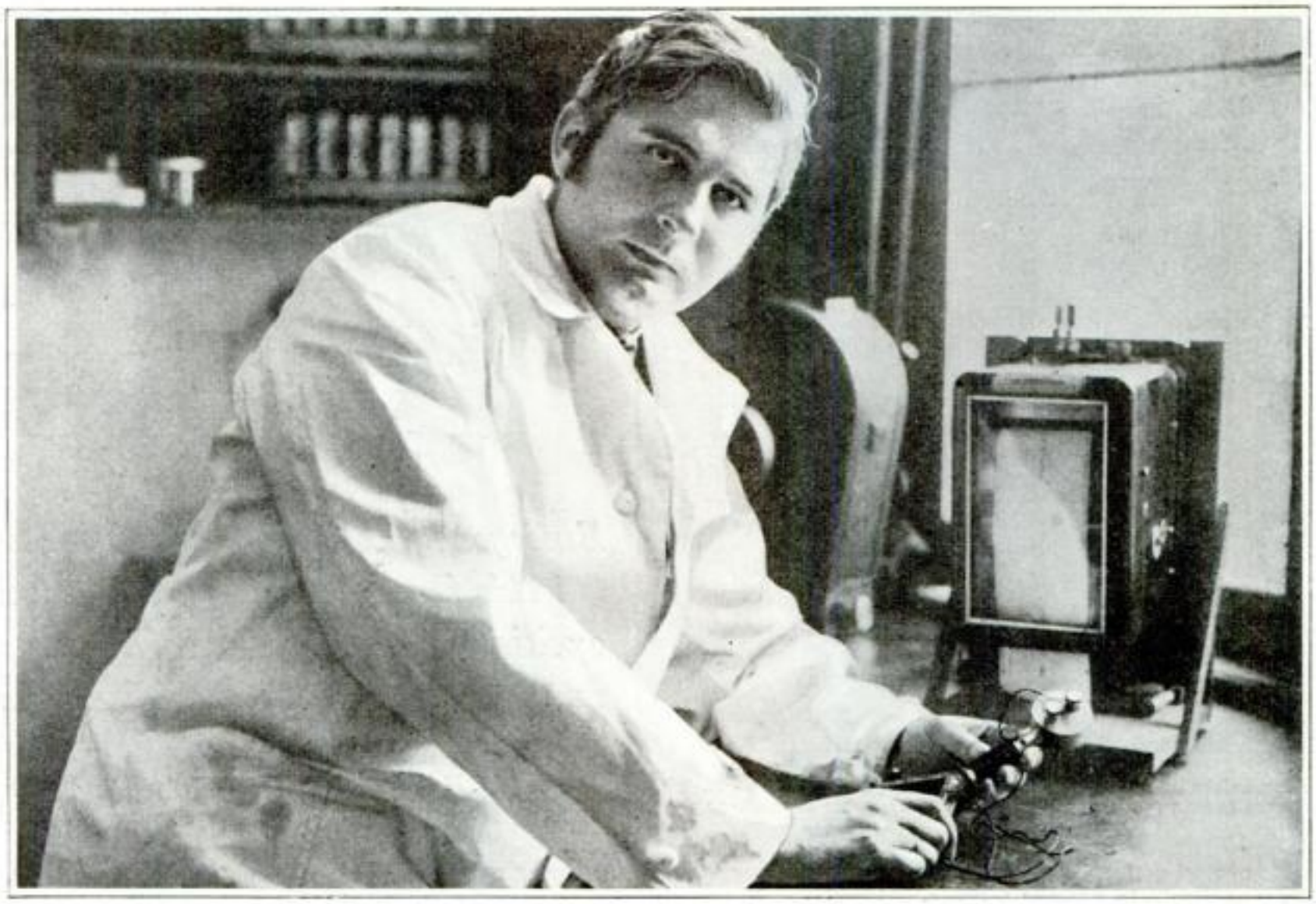
For storm scenes where lightning is supposed to flash, another new piece of apparatus has been developed that looks more like lightning on the film than would the real thing. The new machine, resembling a stationary donkey engine, feeds a mixture of magnesium and cornstarch into an intermittent flame in a hopper. The magnesium flashes and the cornstarch gives the flame body and makes it last long enough to register properly.

The new incandescent lamps give none of the sputtering and hiss of the ordinary arc light.

Curiously enough, the success of the "inkies" was brought about by the new film; and yet lacking the "inkies" the new film would not have represented such an important improvement.

The "inkies" produce a light that is rich in yellow and orange rays, whereas the hard carbon arc light gives less yellow and orange and much more blue, violet, and ultra-violet. It was the ultra-violet rays of the old arc lights that produced so much eye trouble among movie actors.

The new film is of the high speed panchromatic type, which means that it is sensitive to all colors and far more sensitive than ordinary film to the particular rays produced by the "inkies."



Dr. Bruno Lange, who gets power from sunlight, in his laboratory in the Kaiser Wilhelm Institute, Berlin.

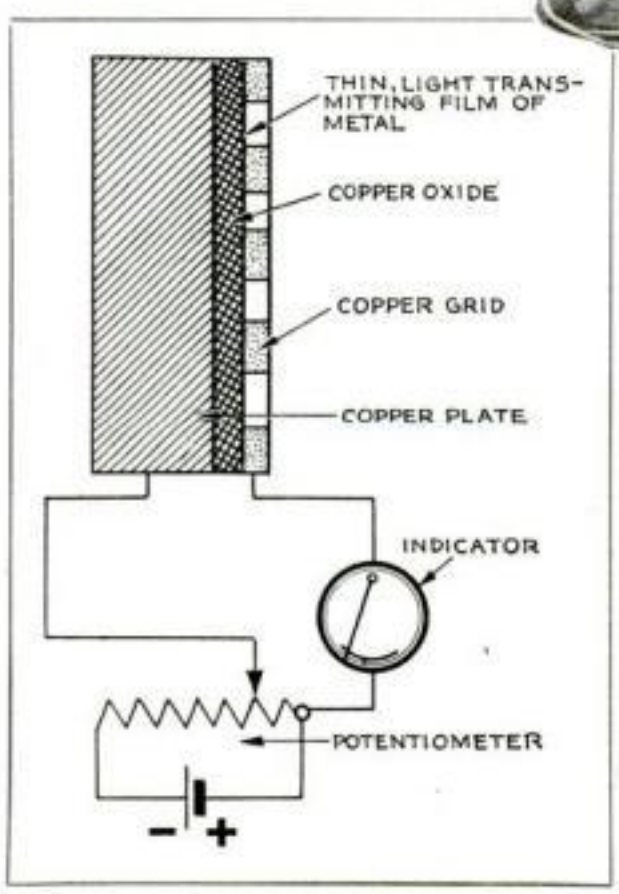
Magic Plates Tap Sun for Power

Silver Selenide and a Secret Metal Used by German to Get Electricity from Solar Rays

AS THIS is written, an amazing lamp has burned each day for several months in a Berlin, Germany, laboratory—an electric light run by current created by sunshine! It suggests the possibility of future use of a vast, inexhaustible, hitherto-untouched reservoir of power.

The inventor of the super-sensitive photo-electric plate that makes this sun-generated current possible is Dr. Bruno Lange, a twenty-eight-year-old experimenter at the Kaiser Wilhelm Institute. In the not distant future, he declares, huge plants will employ thousands of these magic plates to transform sunlight into electric power on a scale that can compete with hydro-electric and steam-driven dynamos in running factories and lighting homes.

At right above, a small motor which Lange has run by photo-electric device shown at left.



Cross section diagram of Lange's sunlight plate illustrating principle of construction.

Several years ago Dr. Lange and others, notably Dr. L. O. Grondahl and Paul H. Geiger in the United States, discovered that copper oxide sandwiched between two layers of pure copper will give off feeble currents of electricity if exposed to sunlight. These tiny streams of power performed spectacular laboratory demonstrations. But as a source of electric power they had no practical value.

Now the young German scientist has produced a new metal sandwich of amazing potentialities. Instead of copper oxide, he uses silver selenide, a combination of silver and selenium, the nonmetallic relative of sulphur used in coloring glass red and the element employed in the photo-electric devices of early experimenters in this field, as the "filling" of the sandwich.

Over this he places a thin layer of a second secret metal, only a few molecules thick. Light passing through this transparent film sets up a current between the two layers of the metal below. When this flow was measured, it proved to be from fifty to 150 times as strong as that coming from the old copper oxide cell.

ONE of these astonishing metallic sandwiches, hardly larger than four postage stamps, was exposed to the light on a dull, overcast day and produced enough current to keep a small motor running in the laboratory.

The inventor calculates that he can erect a huge solar-electric power plant, able to produce 300,000 kilowatts, at a cost no greater than would be required to build a hydro-electric station of the same capacity. To do this the power-producing plates would need a combined area of approximately one square mile. The cost would be $250 a kilowatt or less, the experimenter (Continued on page 134)

Photos by Warren Boyer

Having finished a careful examination of all parts of the plane, Jordanoff is seen ready to climb into the cockpit for the take-off.

Thrills I Get in *Piloting* Air Taxis

Emergency calls for long flights have led this flyer into many dangerous and exciting situations—Careful study of route and plane is secret of success.

By ASSEN JORDANOFF

THE airport telephone jingles. Someone wants to charter a cross-country plane. It may mean a hurry-up jump to Miami, a rush business trip to Chicago, or an emergency dash with a famous surgeon to a hunting lodge in Maine. But, whatever the call, it spells adventure for the man who pilots the flying taxicab.

In twenty years of aviation, I have flown air taxis above half a dozen countries. I have seen a hundred thousand miles of mountains and rivers, plains and farms, slip beneath my wings. I have fought the fog in open cockpit cross-country planes. I have battled the wind in cabin tri-motors.

I have come down for emergency landings in many places—dropped into hayfields, side-slipped into tennis courts, sat down in bumpy cow pastures. I have carried passengers that ranged from the brother of a European king to a poodle puppy traveling to its lonesome mistress!

Last year, a woman was taken sick while visiting friends in a little Wisconsin village. She telegraphed for her physician in New York. We hopped off from Roosevelt Field, Long Island, in a Whirlwind-Fairchild monoplane. We crossed high above the Alleghenies, battled head winds over Ohio, and sat down in a pasture on the outskirts of the Wisconsin village just eleven hours—flying time—from the start.

THE most important passenger-carrying flight I ever made occurred on the day the Armistice was signed, ending the World War. I was flying with the pursuit squadron of the Bulgarian War Birds. A few days before, I had been sent back to Sofia to ferry a new fighting ship to the front.

Before daylight, on that historic November eleventh, I was shaken awake by an orderly. He told me a member of the American legation had to be flown to the front with papers to be signed by the high commanders of the Bulgarian and French armies, terminating hostilities.

A gray, foggy dawn was breaking when I reached the field. The propeller of a fast "D.F.W." was already turning, the 220-horsepower Benz spitting flame into the damp air as it warmed up. Officers in gold braid stood about the ship. I was told the soldiers at the front were revolting. If the Armistice papers were delayed, our lines would crumble; the enemy would break through; hundreds of people would die.

THE instant the fog lightened a little, we roared away into the mist, flying by compass. The route lay over 160 miles of mountains. I took a chance and flew with throttle wide open all the way. The big Benz thundered without a splutter until we dropped down at the front line.

A forced landing and crack-up on that trip would have caused more deaths than any other aerial crash of history.

WHILE the legation man delivered the papers, I collected my personal belongings and piled them into the plane. Among them was a pet hen with a wooden leg. It had been run over by a truck and I had whittled out a wooden stump to replace the leg that was cut off. It hopped all over the place and was the pet of the camp.

On the way back to Sofia, we struck a storm. In the excitement the legation man stepped on the chicken's neck and when we landed it was dead. We decided

Before the take-off is made the pilot receives written orders from the field manager, giving the destination of the ship. From then on he is the captain and in complete charge.

to have a chicken dinner and celebrate the Armistice!

Ordinary cross-country passenger flying is no chance-taking affair like that race to the front. Every possible precaution is taken. When the Operations Manager at the airport gets an order from someone who wants to charter a flying taxi, a regular line of procedure is followed.

At left, Jordanoff completing his examination of propeller hub bolts. Right he is laying out his course on a map.

THE pilots are chosen in rotation and according to their experience with certain planes and over certain territory. Mechanics swarm over the ship. They fill the gas tanks until they will not hold another drop, examine the instruments, adjust the motor, and make a careful check of the plane from "prop" to rudder. The log book of the plane must be signed by a licensed mechanic before the pilot is allowed to take it from the ground.

As a second check on the condition of the plane, the pilot goes over it himself at the last minute. He is responsible for the lives of his passengers and feels more comfortable in the air if he has gone over the ship himself.

At a southwestern air field, not long ago, a pilot hopped off in a hurry in an open-cockpit ship, without looking it over. Two hundred feet in the air, the radiator cap, which had been screwed on loosely, fell off. The wind rushing past the opening sucked water out. The pilot was deluged and half blinded and landed with difficulty.

No worth while mechanic resents having the pilot give the ship a final check. Being careful on the ground is just as important as being careful in the air.

THE final examination of the condition of the plane is made after the pilot takes his place in the machine. He waggles the controls to see that all the control surfaces are working properly. A few years ago, a plane was put on the market with special locks on the ailerons to keep them from whipping in the wind and being damaged when the plane was standing on the ground.

One pilot at Roosevelt Field forgot all about them and hopped off without testing the controls. He was in the air before he found his ailerons were locked and his side-to-side control paralyzed. Only the fact that he was a crack pilot and the weather was unusually calm allowed him to get down without a crash.

Before the take-off is made, the pilot of a cross-country plane receives a written order, giving the destination of the trip. From then on, he is captain of the ship, in complete charge. Each machine has a maximum load it can carry. When there is doubt, the passengers and luggage are weighed. Then, everything is ready for the start.

Usually, at that moment, the concern of the pilot is for the weather rather than the plane. He flies over a wide stretch of territory. The sun may be shining over the airport. But what's ahead? He studies the latest weather reports closely to find out.

On these reports, the character of the weather at different points along the way is indicated by letters. For instance, "B.C." means broken clouds, "O.C." overcast, "F." fog, "G.F." ground fog, "L.H." light haze, and "L.B.C." lower broken clouds. These letters tell a pilot much. But frequently, between the report and the time the pilot reaches the spot, conditions change.

On long flights, the weather is a constant puzzle. Cross-country aces have to be seasoned weather-fighters. But they side-step a battle with ugly conditions whenever possible. An old saying around the hangars is: "The best bad weather flyers are dead."

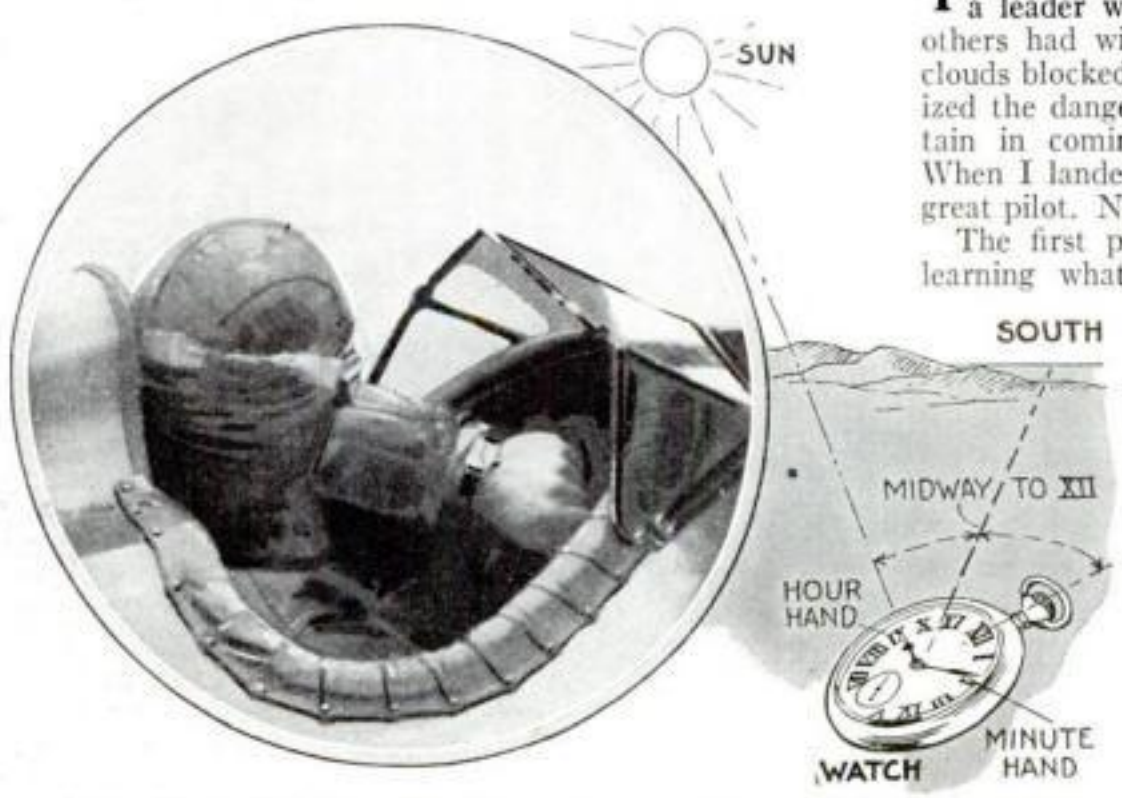
It is only the greenhorn who thinks he can beat the weather. When I was twenty, I was ordered to lead three army planes on a training flight over 125 miles of Bulgarian mountains. The clouds were broken. I climbed above them and the floating fog closed in below me. I didn't know enough to be scared. I kept on.

THEN I looked around and found I was a leader without any procession. The others had wisely turned back when the clouds blocked out the ground. They realized the danger of crashing into a mountain in coming down out of the mist. When I landed safely, I thought I was a great pilot. Now I know I was just lucky.

The first part of a pilot's training is learning what he *can* do. The second part, equally important, is learning what he *cannot* do. Until he has learned both lessons he is not ready to hold the stick of the flying taxi.

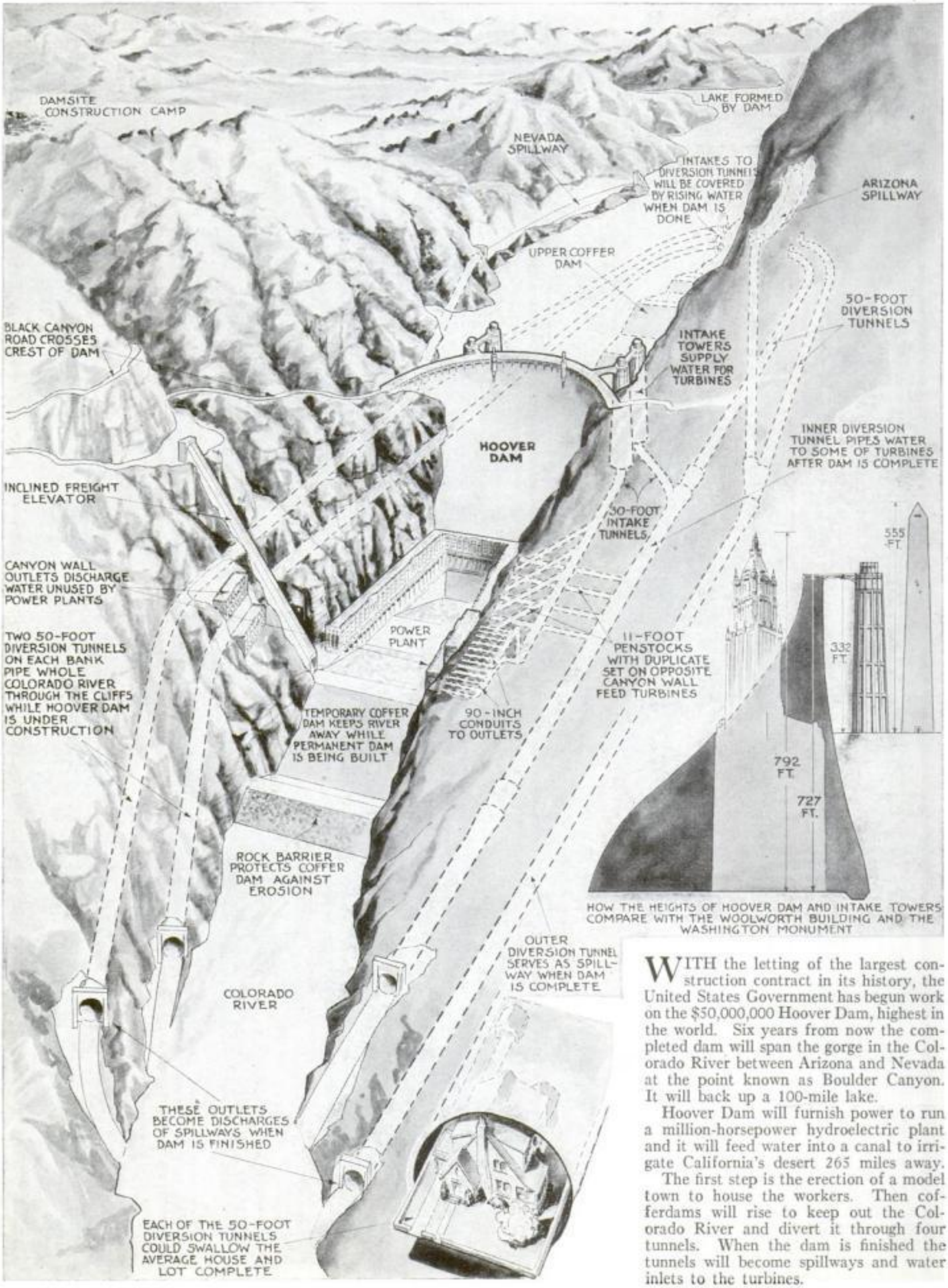
Sometimes a passenger who knows nothing about flying will ask a pilot to keep on against his better judgment. A few weeks ago, a man wanted me to hop off for Chicago when the fog was so thick that visibility was cut down to less than

(Continued on page 140)



Jordanoff once had to use his wrist watch as a compass. To do this, he points the hour hand at the sun and then a line halfway between it and 12 points south.

World's Highest Dam Is Rising



HOW THE HEIGHTS OF HOOVER DAM AND INTAKE TOWERS COMPARE WITH THE WOOLWORTH BUILDING AND THE WASHINGTON MONUMENT

WITH the letting of the largest construction contract in its history, the United States Government has begun work on the $50,000,000 Hoover Dam, highest in the world. Six years from now the completed dam will span the gorge in the Colorado River between Arizona and Nevada at the point known as Boulder Canyon. It will back up a 100-mile lake.

Hoover Dam will furnish power to run a million-horsepower hydroelectric plant and it will feed water into a canal to irrigate California's desert 265 miles away.

The first step is the erection of a model town to house the workers. Then cofferdams will rise to keep out the Colorado River and divert it through four tunnels. When the dam is finished the tunnels will become spillways and water inlets to the turbines.

BARBERS LEARN TRADE SHAVING BLOCKHEADS

APPRENTICE barbers at Frankfort, Germany, learn to shave by using strange looking blockheads. Since it is difficult to get customers for the young men who are being taught to use the razor, wooden effigies of human heads are used. These remain calm and quiet while the students go over them with their sharp tools.

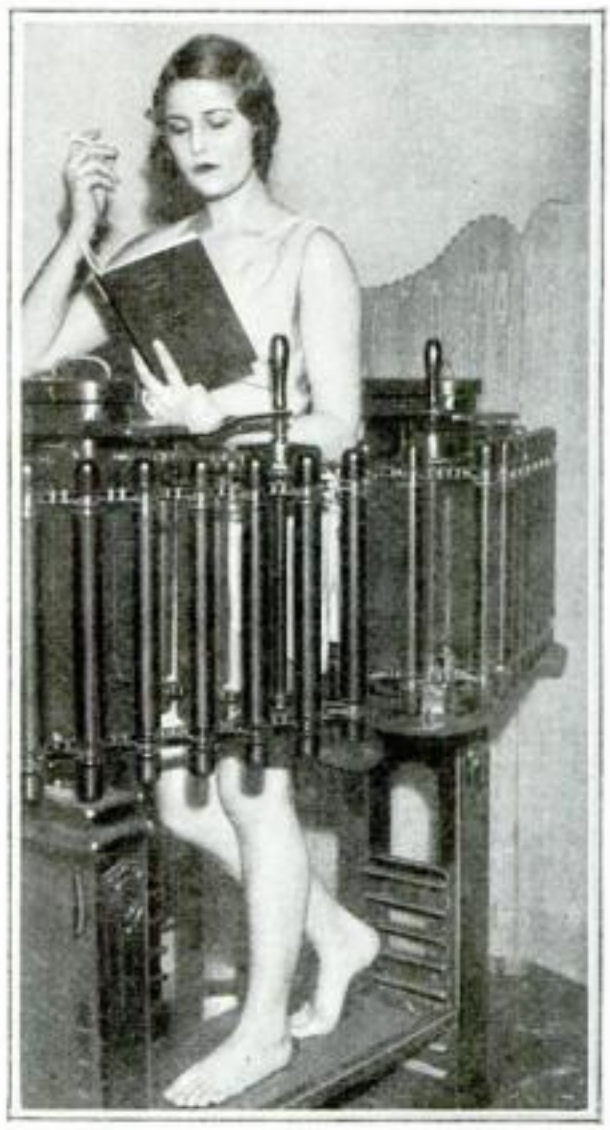
REVOLVING SCORE PAD FOR CONTRACT BRIDGE

CONTRACT bridge players know that it is an advantage for both sides to keep score, in order to keep in touch with the progress of the game, and a novel bridge table makes this easy. Built into its top is a revolving score pad, twirled at a finger's touch to face any of the players. The scoring surface is fitted ingeniously flush with the table top so that cards may be drawn across it, as shown in the illustration, without tearing or bending the edges. The metal plate holding the score pad is adjustable to compensate for the difference in thickness of the pad as sheets are torn off.

VERTICAL ROLLERS IRON OFF SURPLUS FLESH

AN UNUSUAL reducing machine was demonstrated recently in New York City. A series of vertical rollers completely surround the person using it. They can be adjusted to suit users of different girths. Turning a switch starts the rollers going, literally ironing off excess poundage. Those who have tried the machine say the movement of the rollers is so gentle and smooth that no discomfort is caused by them.

The platform upon which the user stands while undergoing the reducing treatment is adjustable to suit persons of different heights, as can be seen in photo.

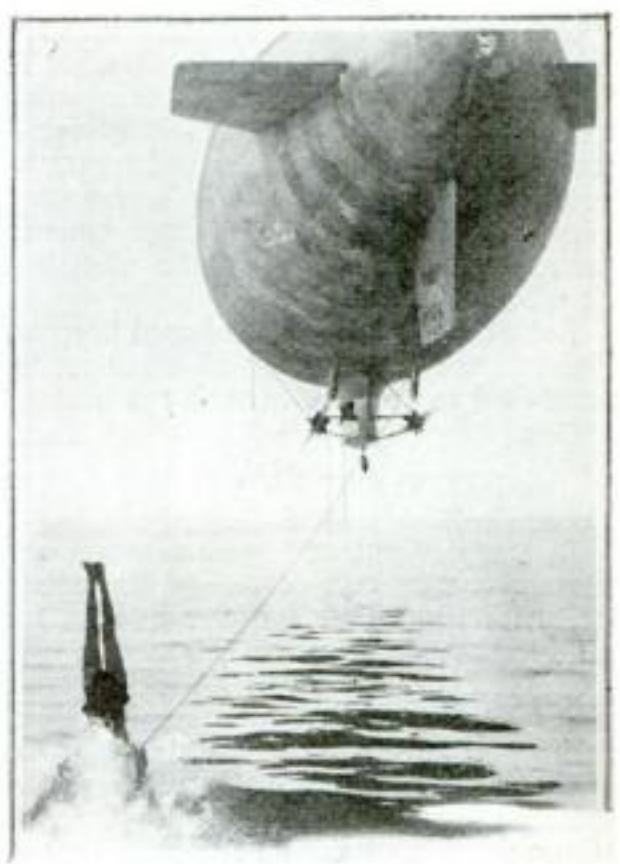


This reducing machine has vertical rollers set in a ring within which the user stands.

A revolving score pad is set in the center of a contract bridge table so that both sides can readily keep score. The device is flush with the table top so cards slide over it.

SPARK PLUG SHOWS FIRING IN CYLINDER

WHETHER every cylinder of your car is firing properly is easy to see when the motor is fitted with a set of new transparent spark plugs. The insulator of each plug is made of a glasslike material having great resistance to heat, provided with ridges to give a cooling effect and make the glow visible. Once installed, it makes visible from the outside the flashes within the cylinder. Absence of a flash in the "window plug" shows that a cylinder is missing. The color of the flash ranges from a deep orange to a pale blue. Blue shows the most perfect combustion, and orange denotes maximum inefficiency.

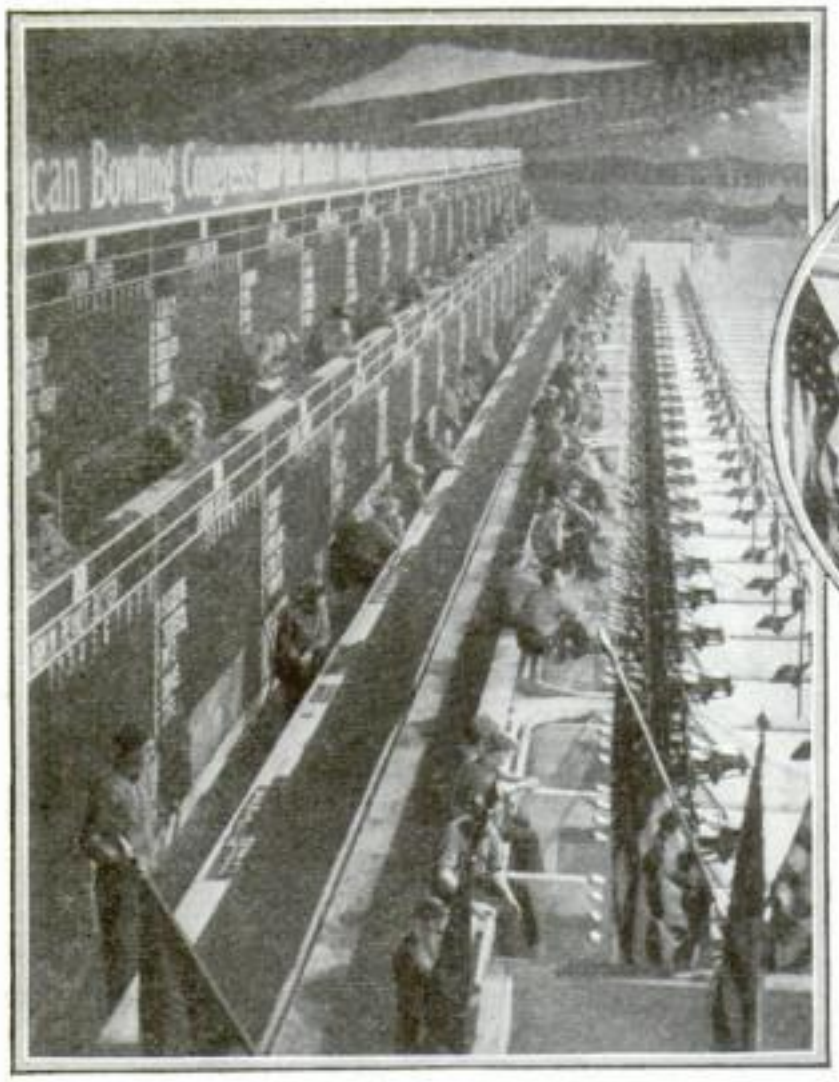


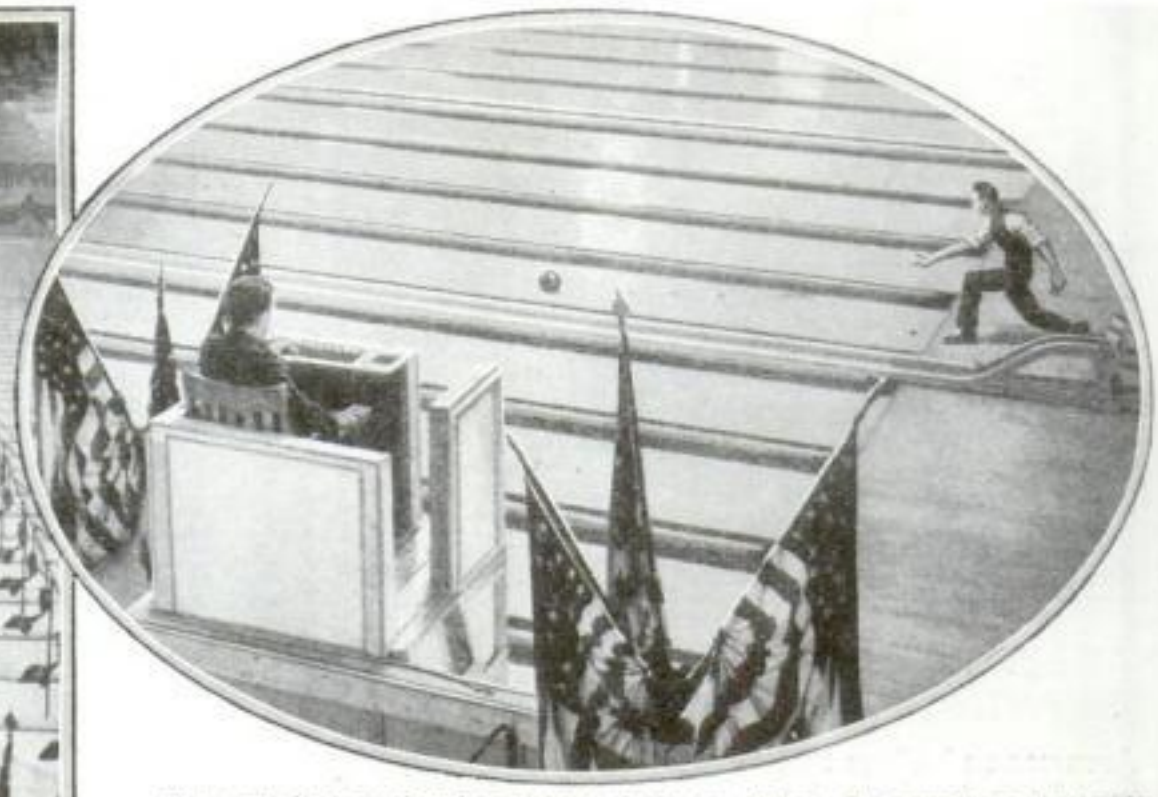
DARE-DEVIL SURF RIDER IS TOWED BY BLIMP

SOMETHING new in aquatic sports was demonstrated at San Pedro, Calif., the other day, when a dare-devil surf rider took a tow from a blimp for the first time in history. Trailing at the end of a 200-foot rope, attached to the Goodyear baby dirigible *Volunteer*, Elmer Peck thrilled spectators by a program of acrobatic feats. Blimp and performer reached a speed of fifty miles an hour before the inevitable spill occurred.

Not long ago Peck set a freak endurance record by aquaplaning behind a motorboat for twenty-four hours.

Electric Signals Used to Flash Up Bowlers' Scores





This foul line monitor has charge of sixteen alleys. By pressing a button he flashes a red light at the foot of the alley when a player has crossed foul line.

At left, the score boards and pin setters ready for action in the Buffalo, N. Y., bowling alleys where electric scorer was installed for meet.

At right, above, is one of the official score keepers operating an electrical scorer. At his left a "courtesy" scorer.

AN ELABORATE electrical system for posting scores eliminated errors and speeded the play at the recent national bowling tournament held in Buffalo, N. Y. Two thousand six hundred and thirty-nine teams kept thirty-two alleys busy for a week, and yet every bowler and spectator could tell at a glance how the scores were going by glancing at the large bulletin boards made possible by the electrical signalling.

Back of the pins are the board keepers. Before each is a battery of small lights, numbered to correspond with the buttons before the score keepers. As each player bowls, the score keeper flashes his score which is then posted on the score board. If the score keeper errs, the board man flashes the red light in his booth.

Electricity also has been called in to aid the foul line monitors in booths overlooking the foul lines. If a player oversteps the line, the monitor presses a button that flashes a red light and rings a bell.

NEW PLUG MAKES AUTO PUMP AIR

A NEW device that can be screwed into the spark plug hole of one of the auto's cylinders turns that cylinder into an air pump that will produce two and a half cubic feet of free air per minute. This much air is sufficient to spray oil paint, germicide, insecticide, and similar liquids.

On the down stroke of the piston in the cylinder to which the device is fitted, the piston sucks in outside air through a spring-operated valve. On the up stroke, this valve closes and another opens, allowing the air to flow into a storage tank or into the pipe leading to the spray equipment. If more air is needed than can be obtained from one cylinder in this way, two of the devices can be used at the same time so as to double the output. It is designed to work at an engine speed equivalent to a road speed of twenty miles an hour.

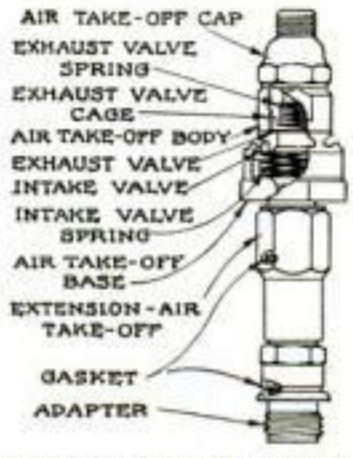


Diagram above shows how car engine, left, furnishes compressed air for sprayer.

MECHANICAL CALCULATOR FOR CONTRACT BRIDGE

A HANDY little device, invented by Mrs. Isobel Brubaker, of Los Angeles, Calif., calculates contract bridge scores quickly and easily. Two white disks bearing numbers and scoring figures rotates between composition holders.

Projecting slightly beyond the edges of the holders, the disks are easily turned by pressure of thumb and fingers. Users of this device say it saves them time in totaling up scores, helps keep their minds on the game, and greatly reduces the possibility of error.

The calculator is small and light, and it may be carried in pocket or hand bag as easily as a small purse.

ELECTRIC EYE KEEPS CLOCKS ACCURATE

Photo-electric cells are used in a big plant to control all the clocks and once a second check them for accuracy.

ENGINEERS at the General Electric Company's plant in Schenectady, N. Y., have given photo-electric cells the job of checking time in two different ways. Faced with the problem of comparing the company's master clock with the Government time signals on a daily schedule, they used a photo-electric cell to avoid any mechanical interference with the clock. The cell was placed on one side of the pendulum with a light on the other side. The moving shadow of the pendulum thus produces an impulse every second and this impulse operates a chronograph that compares its timing with the signal from Washington.

In the other service, three photo-electric cells control the generator that runs the clocks throughout the plant. Light flashing through one slot in a disk operates a cell when the generator runs too fast. When slow, the other cell gets a flash. When right, the middle cell receives light.

RUBBER, GOLD, SILVER IN TINY HUMAN SKELETON

A REMARKABLE small-scale model of a human skeleton was completed recently by Miss Catherine Doret, a Los Angeles, Calif., dental assistant. Hard rubber, gold, silver, and dental plaster were used in making the skeleton. All of her spare time for two years was given to the job. When not on display the small skeleton is kept in a reproduction of an Egyptian mummy casing, at left in photo above.

HOUSE NUMBERS ON CURB AID TO MOTORISTS

Two Los Angeles, Calif., youths recently turned an ingenious idea into a profitable occupation when they evolved a plan for making house numbers more plainly visible to passing motorists. When they appeared before municipal officials, their scheme to paint house numbers in large type upon a whitened section of curb met with approval and they readily obtained a permit. Armed with this sanction, they procured a number of orders from householders in the residential section. The figures, neatly stenciled on a uniform white background, are easily seen by the light of the street lamps.

FRESH WATER ON TOP OF SEA

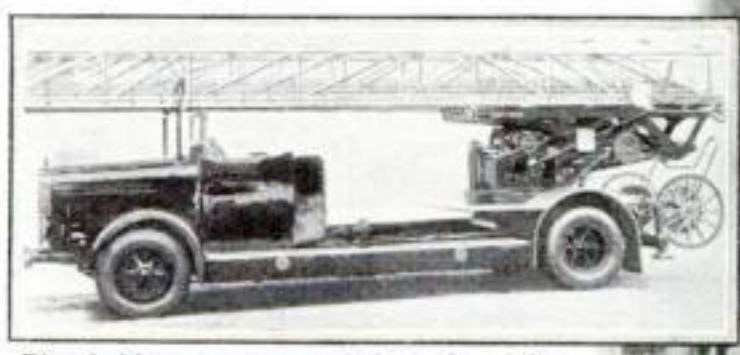
THE sea isn't always salty. Recently explorers found a thirty-foot surface layer of fresh water at some places in the Arctic Ocean. Their explanation of the apparent paradox is that melting snow and ice from glaciers and icebergs supplied the fresh water.

ONE TRUCK CARRIES FIRE LADDER 125 FEET LONG

ONE of the latest pieces of equipment for German fire fighters is a novel extension ladder that can reach a height of 125 feet when fully extended. It is mounted on a motor truck of its own and raised and lowered by machinery.

A rotating base supports the ladder in such a way that it can be raised in any direction without moving the truck. The ladder is made in five sections that slide over each other, something like the sections of telescopes. Sides, rungs, and braces are of steel, making it fireproof.

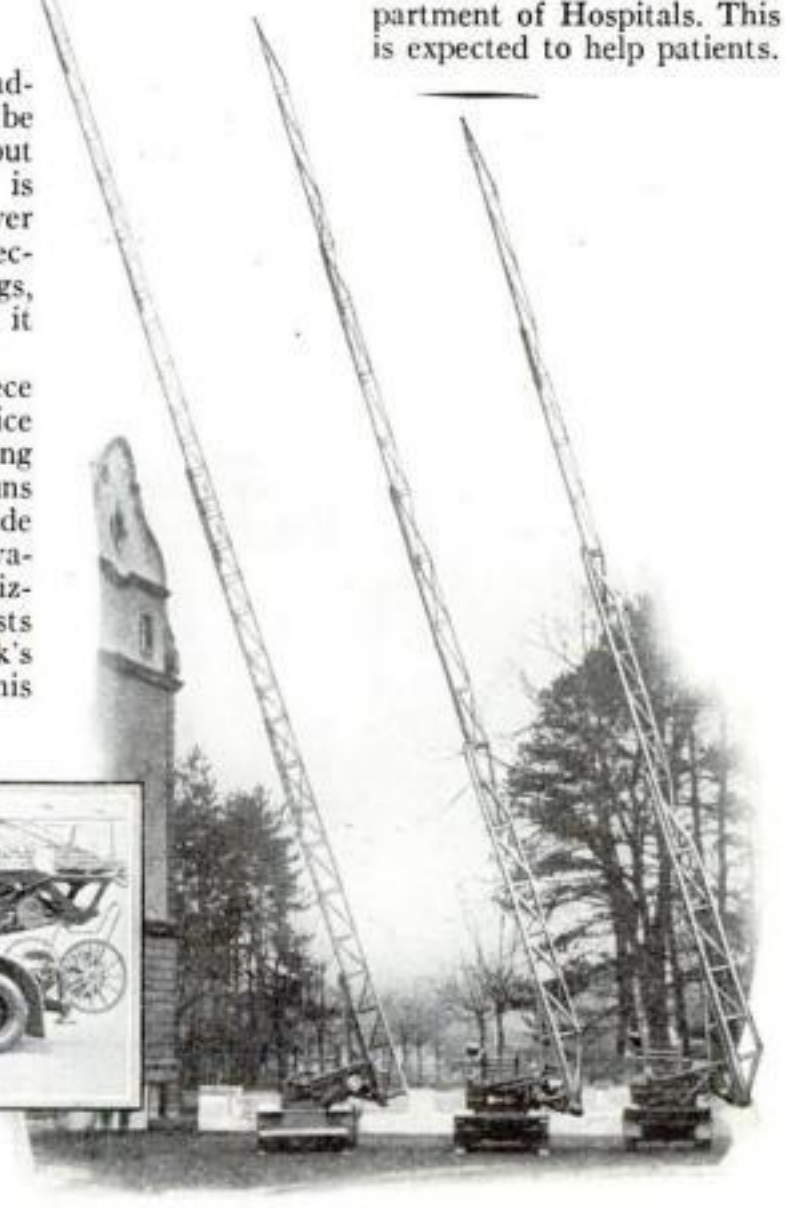
A novel attachment on this piece of fire apparatus is a safety device for lowering people from burning buildings. A rescue "basket" runs up and down the ladder in guide rails. It is used when rescuing invalids, or people incapacitated by dizziness, from high buildings. Tests of this part of the German truck's equipment were described in this magazine last month.



Fire ladders, seen extended at the right, can be drawn out to 125-foot length. Telescoped, each is carried on truck, above.

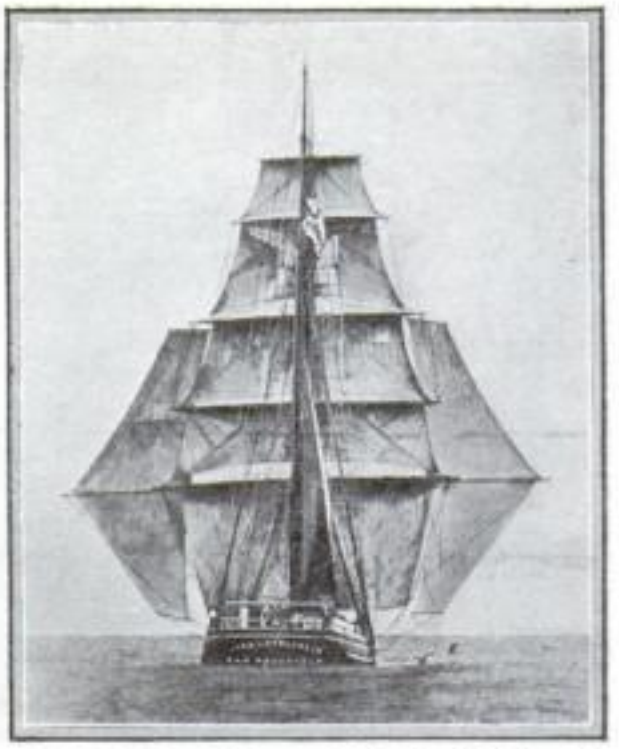
GIVE SICK GAY COLORS

WALLS in New York City hospitals will be painted red, green, yellow, blue, and purple, according to Dr. H. G. Greef, Commissioner of the Department of Hospitals. This is expected to help patients.



Star Fleet operated by —
Alaska Packers
111 Calif. St.
San Francisco.

Lady Isabella, with her canvas clewed up, works her way cautiously to anchorage after rounding Horn.



John D. Spreckels was a little old lady of the sea. Her stun-sails were once popular.

Yesterday They Ruled the Sea

What has become of the majestic windjammers? On this page you see them as they were when they sailed the waves in all their glory. On the next page pictures tell of their final anchorages.

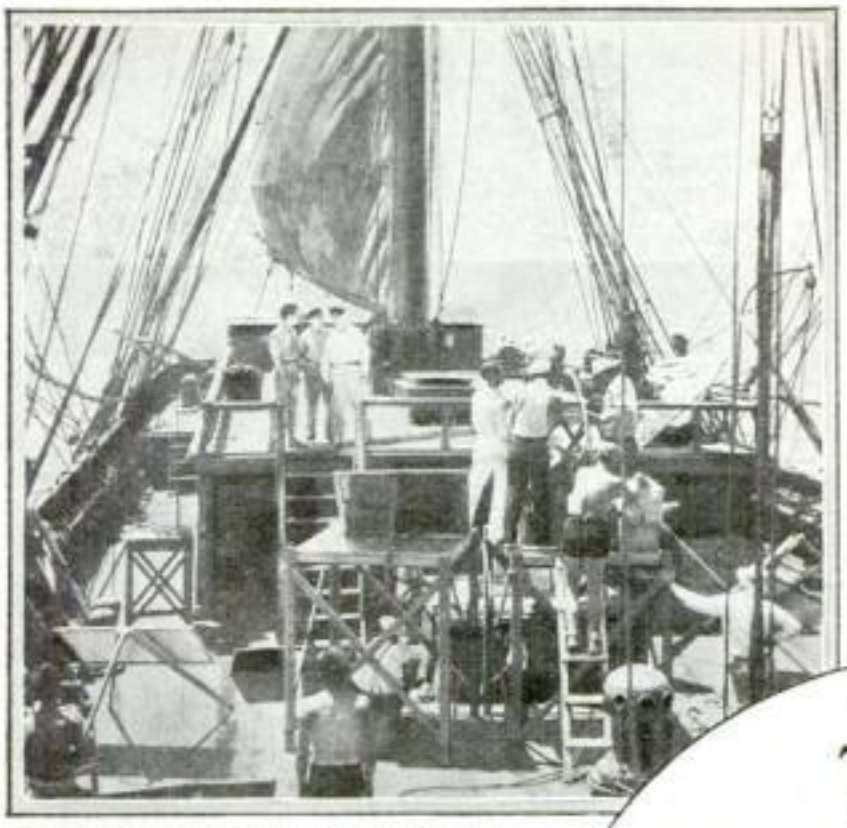
The *Golden Gate* as it looked on two-year voyages with strange cargoes to far places.

Dashing Wave, sure of herself and her master, sails up to anchorage with mud-hook ready.

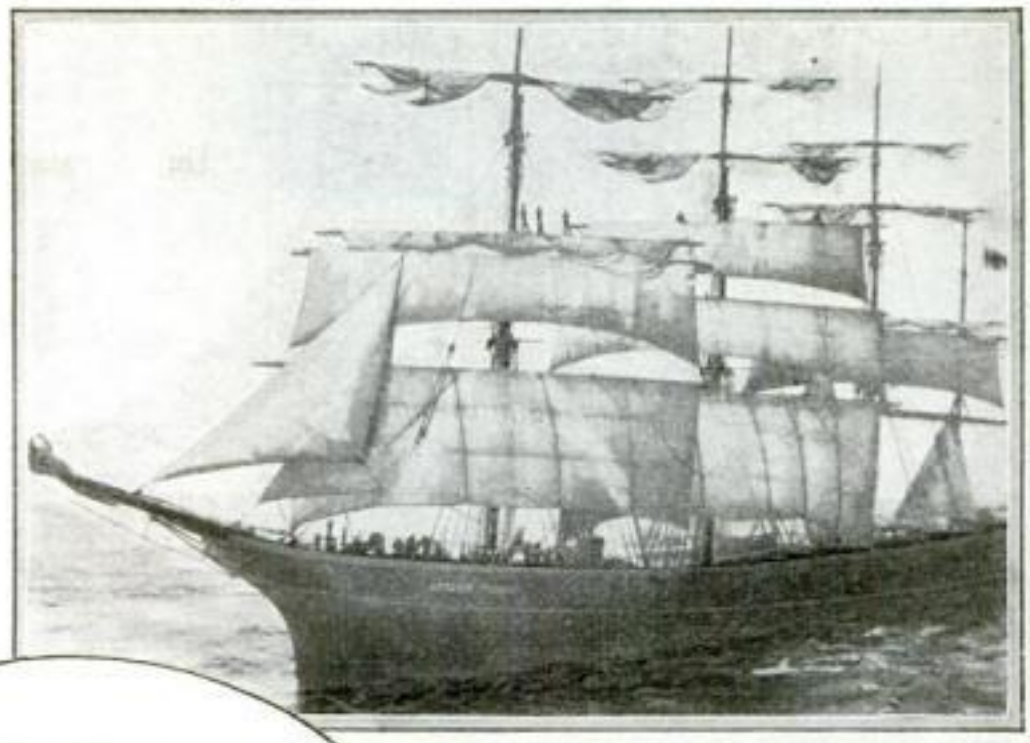
Star of Lapland, when she quit service five years ago, boasted that she was the largest square-rigger in American registry. She was built at Bath, Maine, in 1902, and was 300 feet long.

At left, *Star of Shetland*, one of the last of the big steel windjammers laid in American yards. She had steam deck machinery but was propelled by wind.

Star of Peru, a modified clipper, was built of iron before the age of steel and was a smart looking boat.



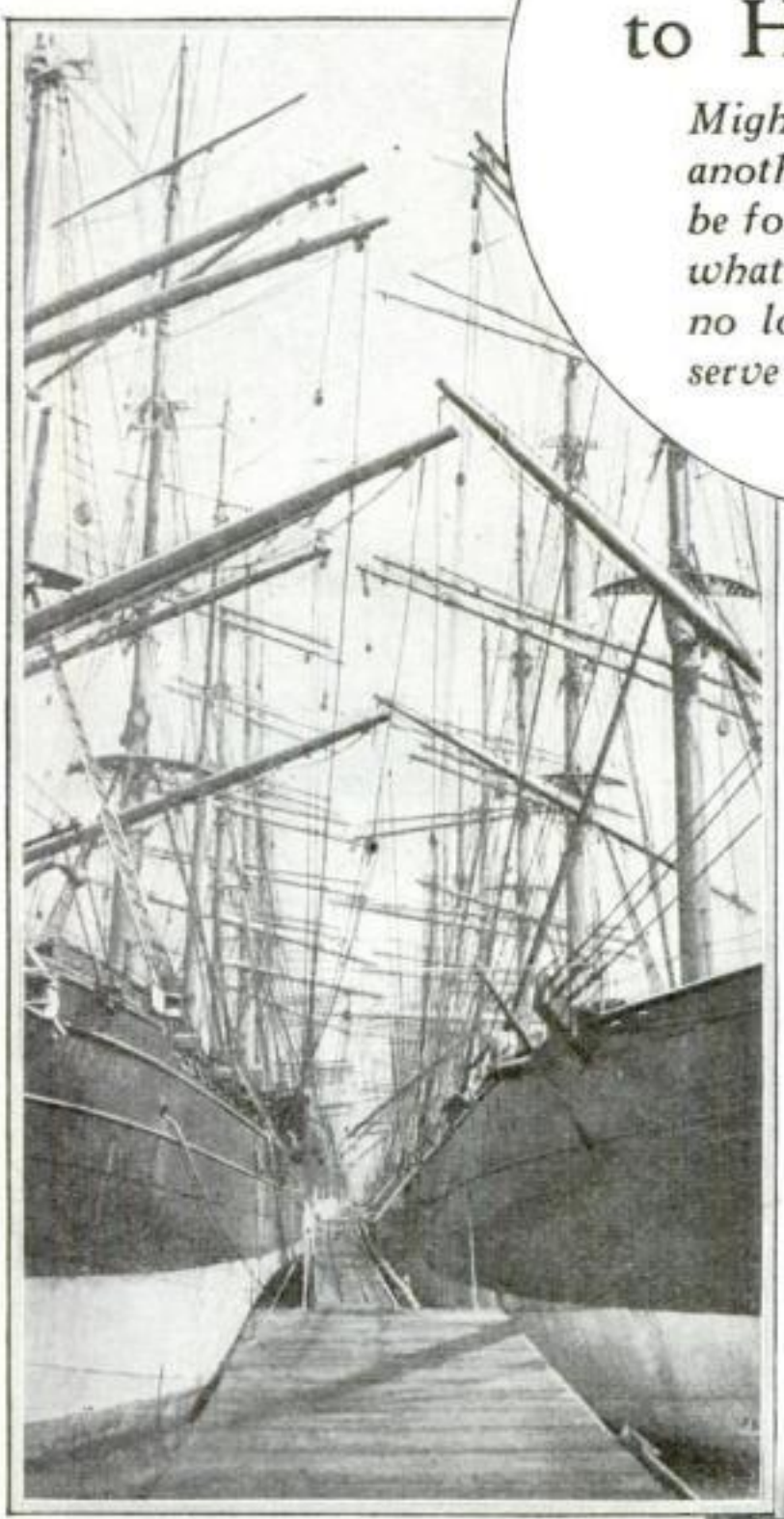
One of the old white-wings of the sea no longer sails the waves but serves as a set in making of marine movies.

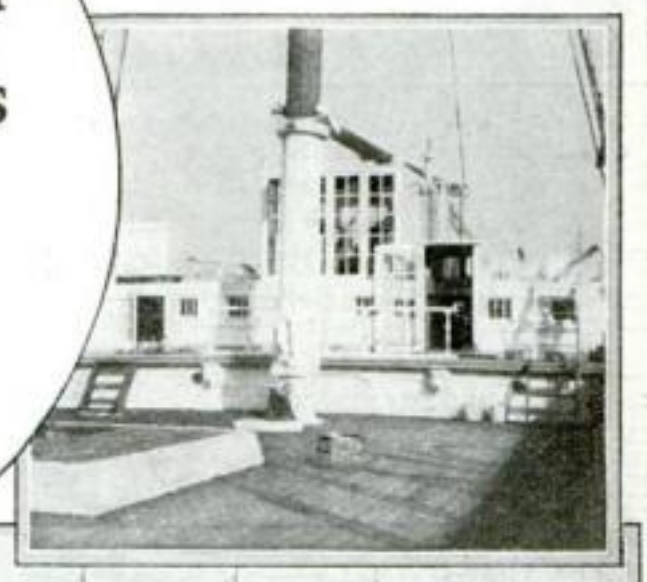


Abraham Rydberg still clings to the ocean, as she is manned by forty apprentices training for a sea-going career.

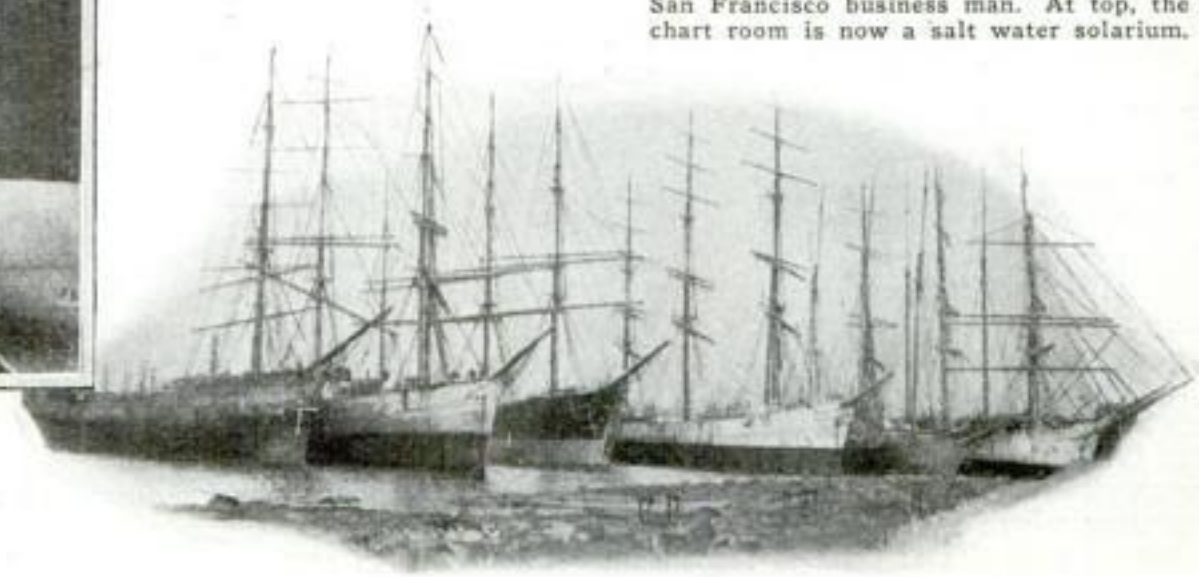
Today They Lie Bound to Humble Uses

Mighty sailing ships of another century can still be found if you know in what spots to look. They no longer sail but they serve as schools, homes, or movie sets.



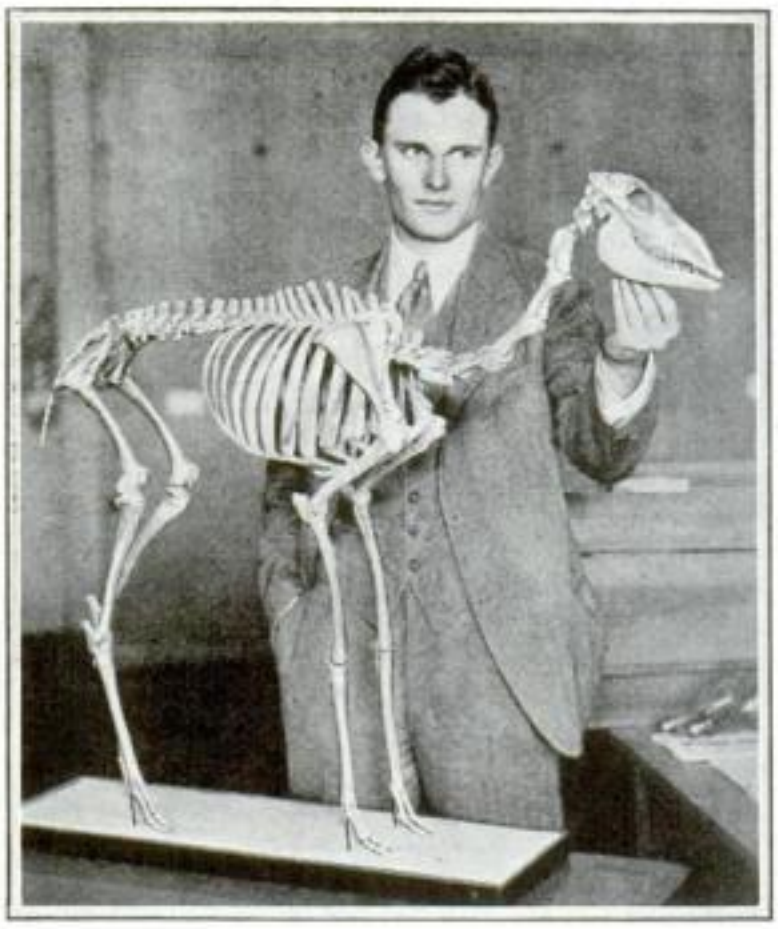


Echo has been turned into a home for a San Francisco business man. At top, the chart room is now a salt water solarium.



At right and above, crack ships of a former day have come to their last anchorage and are tied up on mud flats or in abandoned docks and are left to fall slowly to pieces. At left above is *Star of India*, built during the Civil War days and still in excellent condition. Steam has banished her from the seas, and she lies useless and forgotten at Alameda, Calif.

CAMELS HERE 17,000,000 YEARS AGO



Nebraska was once the home of this tiny three-foot camel whose skeleton is now in Harvard museum.

ADDED to the Harvard University Museum at Cambridge, Mass., the other day was the skeleton of a tiny camel that once roamed the Western plains of this country. It was found at Agate Springs, Nebr., by geologists of the university's research department. According to them the little animal was about three feet high and lived 17,000,000 years ago.

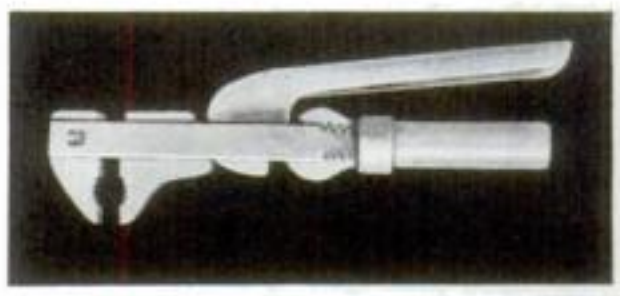
WALK THROUGH GIANT LEAF

AN ARTIFICIAL corn leaf 160 feet long by thirty-six feet thick will be one of the exhibits at the Chicago International Century of Progress Exposition to be held in two years. Visitors will be able to walk through the huge leaf, much as tiny germs might pass through the leaf itself. Lights will imitate the sun shining through the leaf.

VISE GRIP ON WRENCH STOPS ALL SLIPPING

A MONKEY wrench that tightens its grip on nuts or boltheads the harder it is applied is a new tool for mechanics. It is made by a Binghamton, N. Y., firm. A round nut in front of its handle regulates the jaw opening to the approximate size required. The user then applies the wrench to the nut, gripping a latch over its handle as he does so.

This clamps the jaws tightly in place, making it impossible for them to slip. When the user removes the wrench from the work, he simply releases the latch and its jaws immediately slacken. This unusual tool is being fitted with pipe wrench jaws operating in the same manner. A wire cutter is fitted under the latch.



The latch on this vise grip wrench clamps the jaws tight so they can't slip from nut.

PHOTO FLASH BULBS GIVE UNDERWATER PICTURES

STUDENTS of marine life or amateur photographers now may take underwater pictures without wetting their cameras. Edward Sanderson, of Portland, Ore., demonstrated recently that this could be done by the aid of the new electric photo flash bulbs.

He set up his camera close to the surface of the water over a shallow spot. It was focused on the bottom through a tube and hood that led from its lens to a point just under the surface.

Three of the bulbs with reflectors, mounted in a cluster, were submerged close by. Snapping the switch and the camera resulted, Sanderson says, in an excellent picture of marine life under the surface. Waterproof insulation for electric wires was used, and the camera was loaded with a new high speed plate.

With three photo flash bulbs and reflectors, photographers are now able to take pictures under the water.

ALL NATIONS SAY "STOP"

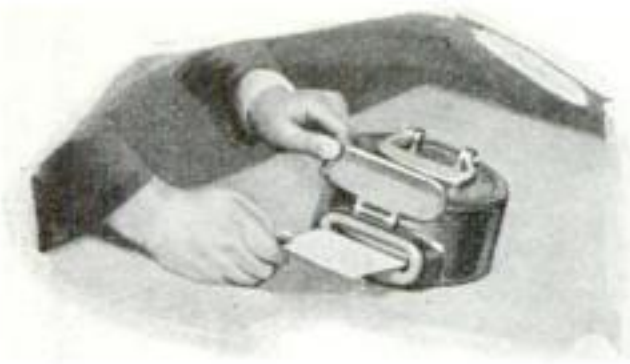
MOTORISTS in foreign countries find the word "stop" on traffic control signs almost everywhere, regardless of the language spoken. Tourists traveling over the mountain roads in Albania saw this English word on traffic signs as frequently as signs printed in the native tongue. In Bucharest, the capital of Rumania, both "start" and "stop" are commonly used for traffic signs. The need for a universal traffic language where much motoring between different countries is done is responsible for the use of these English words.

LEVER OPENS WINDOW IN GERMAN RAILROAD CAR

A CONVENIENCE on German railway trains is a device by means of which passengers may open sleeping car windows themselves. Without rising from his seat, a traveler grasps a small lever at the window sill, opening the window quickly and easily. Formerly a strap was used for this purpose, as the European car windows slide to one side instead of rising as they do in America.

Use of this device eliminates the necessity for passengers to get up and tug at the sashes that have jammed or call for attendants to open them. When not in use the lever folds up out of the way.

Travelers in German railroad cars can now open windows with little effort with lever.



COVER ON CASH HOLDER LIKE GUN'S BREECHBLOCK

BORROWING an idea from builders of big guns, a Chicago, Ill., manufacturing firm has designed a new thief-proof money holder for commercial establishments. A heavy steel cylinder is fitted with a circular hinged cover like the breechblock on a big gun. Beneath the cover is a sloping slot through which cash, inclosed in envelopes, is deposited. This has a hinged flap cover that opens outward. At the inner end of the slot is another hinged flap, fitted with teeth like a garden rake, that works in the opposite direction.

The flaps make it impossible for money envelopes to be taken from the holder without opening its cover.

COIN IN SLOT UNLOCKS PUBLIC TYPEWRITER

COIN-IN-THE-SLOT typewriters for public use in hotels and postal and telegraph offices have been designed by a German firm. Putting money in the slot, a depositor may make 1,000 strokes with the machine. Attached to it is a device counting strokes as they are made, showing the user when he is approaching the end of his number. When 1,000 have been made the machine automatically locks until another coin is deposited.

Ten German pfennigs—about the equivalent of two and one half cents in our money—open the new typewriter.

TINY BULB BRIGHTER THAN BIG BROTHER

EXTREMES in the sizes of electric lamps were demonstrated recently at Cleveland, Ohio, when one of the new photographic flashlight bulbs was shown beside a monster incandescent lamp of 150,000 candlepower. The flashlight bulb could hardly be seen beside its huge brother. Small as it was, however, it could give more light for a short time than the big lamp could.

When you press the button to take pictures by the aid of one of the electric flashlight bulbs, which can be carried in a coat pocket, you release light of 500,000 candlepower. The brilliant illumination of this lamp, though, lasts for less than the wink of an eye, while the less powerful glare of the bigger bulb could shine steadily for one hundred hours if necessary. The size of the big bulb is strikingly suggested in the picture at right.

The photographic flashlight lamp was recently introduced to supplant the noisy and messy flashlight powders formerly used in taking photographs indoors or at night (P.S.M., May '31, p. 27).

Here is photographic flash bulb that gives 500,000 candlepower beside a giant 150,000-candlepower lamp.

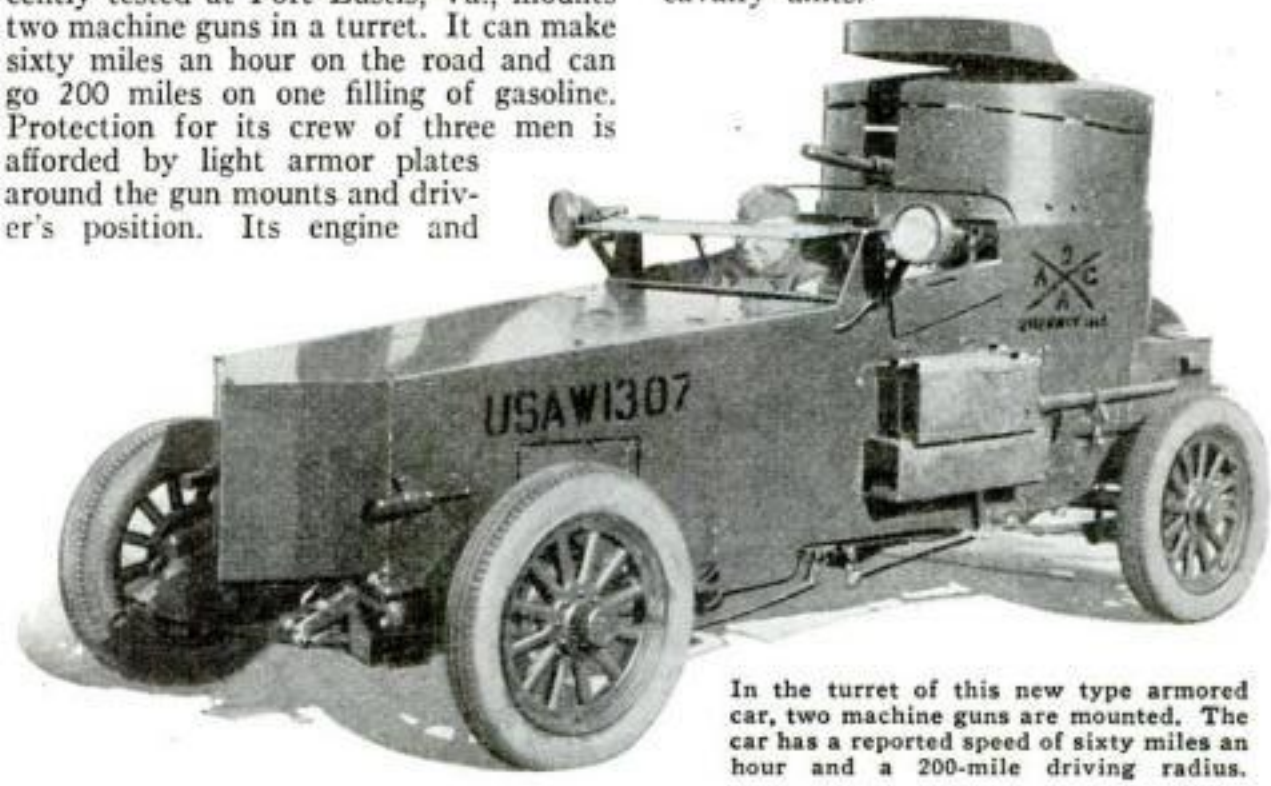
When attached to hose, water flows through this rubber sponge to speed washing of car.

RUBBER SPONGE FITS ON HOSE TO WASH CAR

DESIGNED for use in washing dust from motor cars is a rubber sponge put out by a Trenton, N. J., manufacturer. Fitted to a short length of hose, water flows through the sponge before reaching the auto's paintwork. Both washing and scrubbing are done in one operation by use of this device. Water flowing through the sponge keeps it always clean.

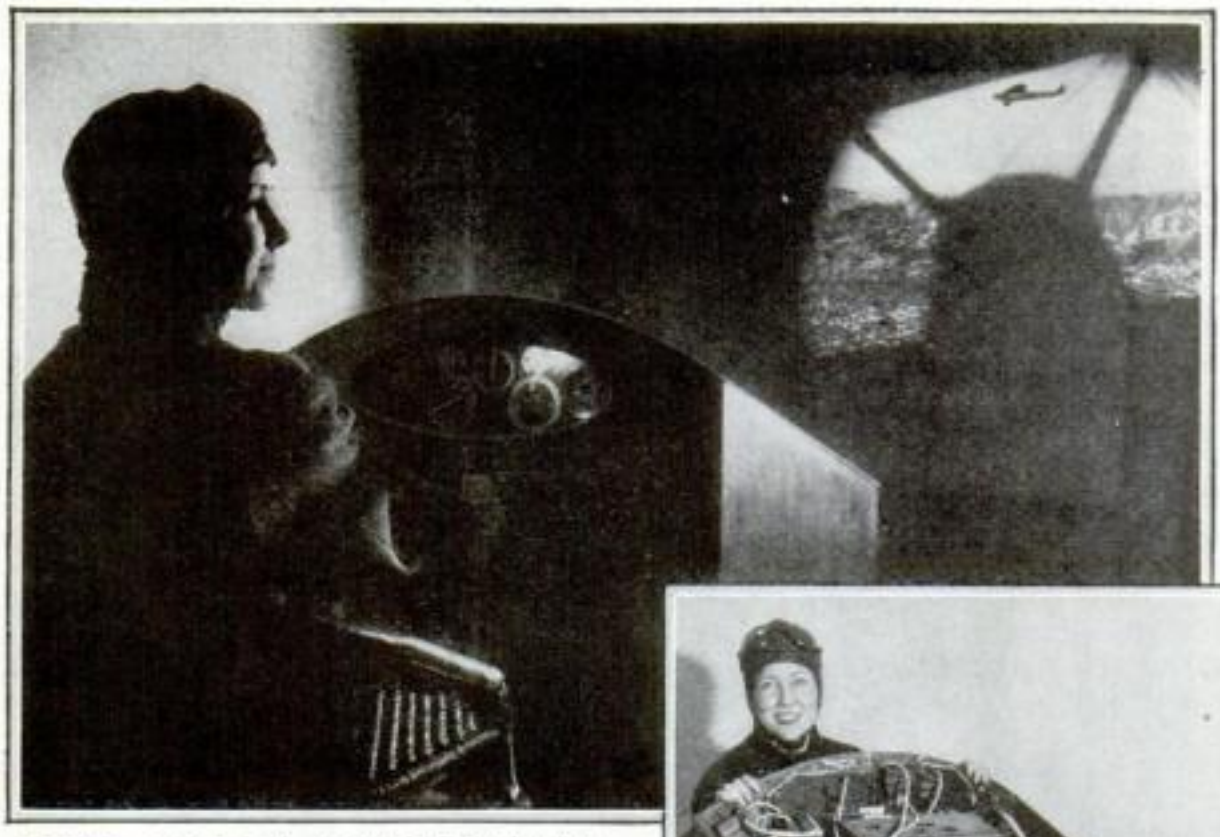
NEW ARMORED CAR'S GUNS IN TURRET

ONE of the latest of Uncle Sam's mobile weapons for war on the land is a light armored motor car. This machine, recently tested at Fort Eustis, Va., mounts two machine guns in a turret. It can make sixty miles an hour on the road and can go 200 miles on one filling of gasoline. Protection for its crew of three men is afforded by light armor plates around the gun mounts and driver's position. Its engine and many parts of the running gear are protected from enemy bullets in the same manner. It will be used as a fast scout by cavalry units.



In the turret of this new type armored car, two machine guns are mounted. The car has a reported speed of sixty miles an hour and a 200-mile driving radius.

ROBOT CONTROLS GIVE FLIGHT PICTURE

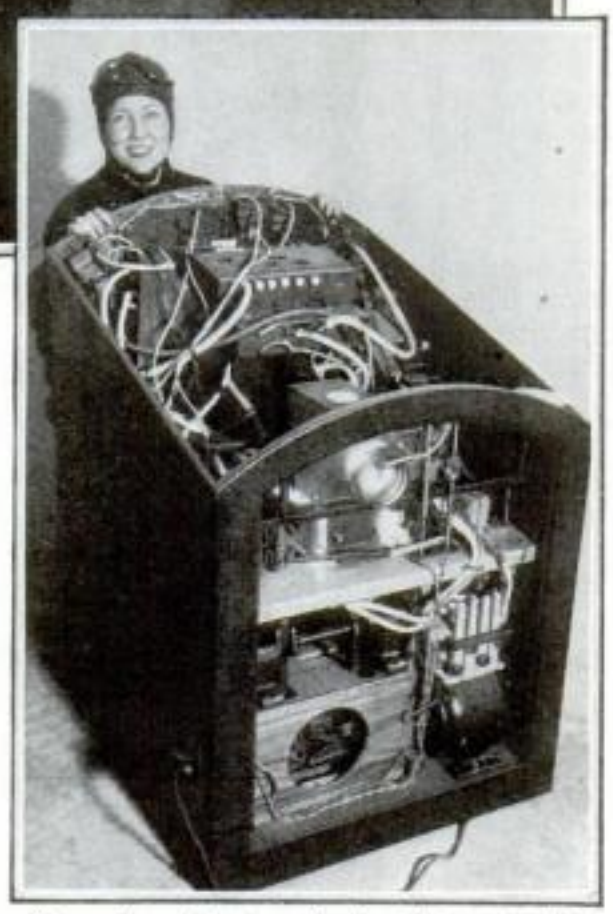


Moving controls of mechanical instructor throws on the screen a picture of real flight.

A MECHANICAL flying instructor was shown in Los Angeles, Calif., recently by its inventor, George Bosson, of that city. The student pilot sits at a standard set of airplane controls—stick, rudder bar, and throttle—with a regular instrument board before him fitted with blind flying and engine-recording instruments.

As he opens the make-believe throttle, a representation of the horizon as seen from a plane during take-off, flight, and landing appears on a screen in front of him. On it are shown engine housing, wing struts, and propeller. Operating the dummy controls causes this picture to change as it would for corresponding movements of the controls in a real plane during flight.

The picture tilts from side to side as the student makes a banking turn. Opening or closing the throttle causes an indicator to register changes of speed.



Internal mechanism of robot instructor that gives flight picture on ground is revealed above with student before instrument board.

RADIO BEACON TO GUIDE PLANES BACK TO SHIP

NOT long ago two squadrons of naval planes, carrying seventy-two men, wandered too far from their mother ship, the carrier *Lexington*, and became lost at sea. They found their way back safely only after dark, when the carrier's searchlights pointed the path home. As a result, carriers are now to be equipped with radio beacon stations that will guide flyers to a safe landing.

The new system is made possible by an unusually lightweight radio beacon outfit, illustrated above, which will be installed in the larger planes of each carrier squadron. A needle swings toward "L" or "R" on a round dial to show the pilot whether he is bearing to left or right of the course indicated by the carrier's beacon. Small planes, unable to carry radio sets because of the weight, will follow the larger aircraft home as birds in a flock follow their leaders.

NEW FIGHTING PLANE CARRIES SIX GUNS

A NEW wasp of the air recently delivered to the British Royal Air Force is a flying gun mount. The wicked little high-speed single seater carries no fewer than six machine guns, fixed so their fire focuses on one point ahead of it. Like the big guns of a battleship, all of which may be fired by one man, all six of the new fighter's machine guns may be fired by the pilot.

Four of the guns are mounted in the leading edges of its wings—two in the upper and two in the lower wing. They are spaced well out from the fuselage, two on either side. The remaining two guns fire through slots on each side of the cockpit, sending their hail of lead through the whirling blades of the propeller. In level flight the new plane can roar through the air at 200 miles an hour, and it can climb three miles in nine minutes.

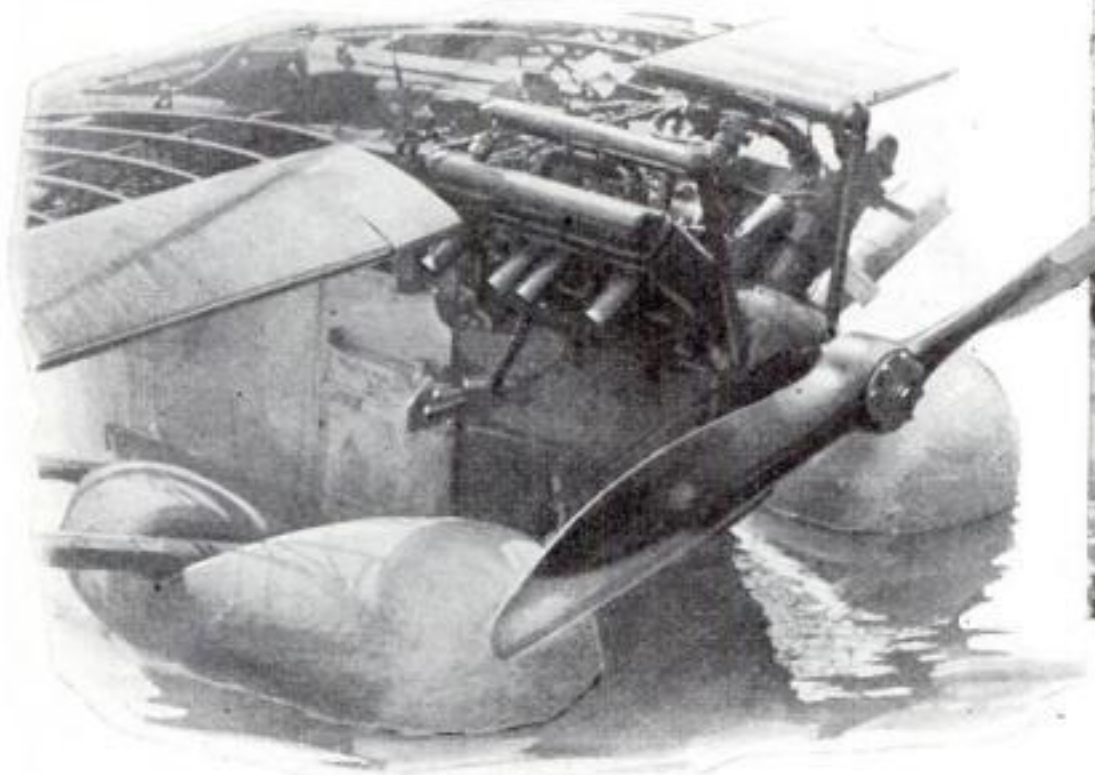
England has just made successful tests with this fighting plane that carries six machine guns, all of which can be fired by one pilot and which center their fire on a point ahead of the plane. At left, pilot is pointing out some of the guns on this flying gun platform.

Emergency Gas Bags Save Land Planes Down at Sea

LOST over the shark-infested Pacific Ocean off Panama—and out of gas! Chief Aviation Pilot Verne W. Harshman, U.S.N., had strayed and could not find the aircraft carrier *Langley* and the airplane fleet. Now his motor sputtered and died. The plane, a land-flying type, splashed into the sea. But it didn't sink.

Just as one wing went under Harshman pulled a lever. There was a hiss of gas, and a pair of balloon-shaped bags beneath the lower wing swelled up. They buoyed up the plane until next morning. Meanwhile Harshman leisurely stocked an emergency rubber boat with oars, a canteen of water, a red signal flag, and a Very pistol to fire distress signals at night. Then he cast off. Four days later a passing liner picked him up.

After months of tests these airplane life preservers, officially known as "flotation gear," have come out of the experimental stage. Practically every Navy land plane or carrier aircraft now uses them as a safeguard against an emergency landing. They are inflated by carbon dioxide gas compressed in tanks.

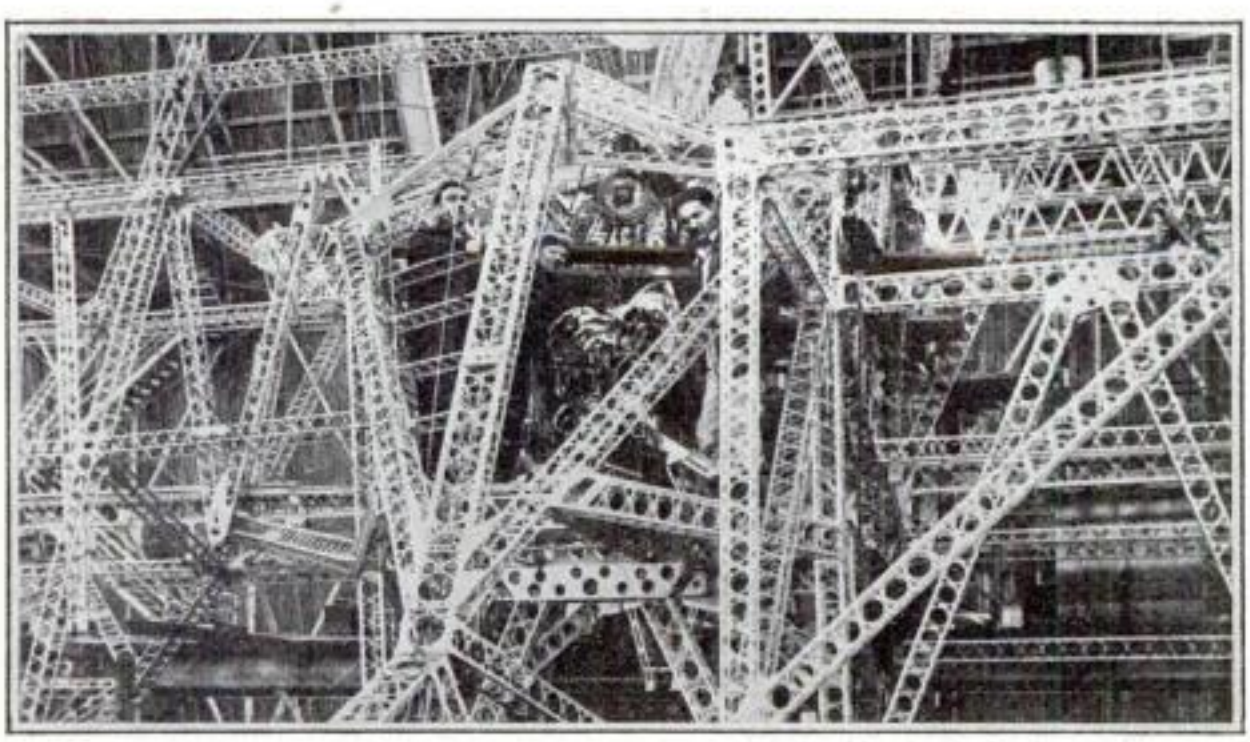


Above, drawing shows how flotation gear kept a Navy land plane afloat while the pilot got his rubber boat ready to escape. At left, a plane resting on the water and being buoyed up by the gas bags beneath wings.

MOTORS PLACED IN GREATEST AIRSHIP

HIGH amid what appears to be a tangled mass of girders, mechanics are installing motors that will drive the huge Navy airship *Akron,* largest in the world, now nearing completion at the Goodyear-Zeppelin dock in Akron, Ohio. They will break all precedent in airship construction by being placed inside the hull.

Earlier airships had the motors on the outside because the ships were lifted by hydrogen gas. An exhaust flame or electric spark might ignite the highly inflammable gas. When noninflammable helium inflates dirigibles, such precautions are unnecessary. The engines will drive propellers that can be pointed in any direction to propel the ship up, down, forward, or backward.



This bewildering maze of girders, which seem to crisscross aimlessly, are the steel supports inside the giant airship *Akron.* Mechanics can be seen installing the ship's big motors.

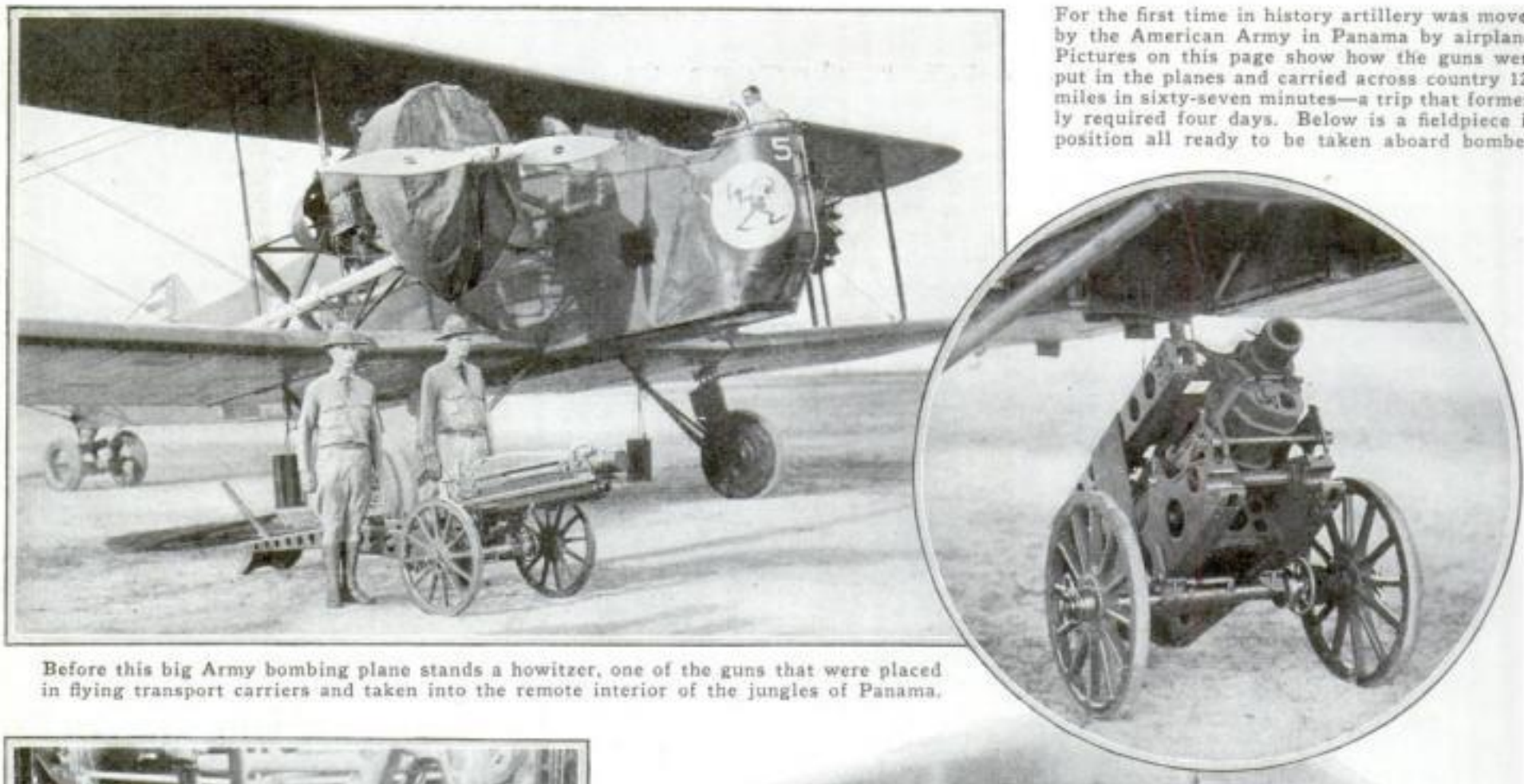
SPRING CLIP ON DISHES DESIGNED FOR AIRPLANE

SPECIAL crockery for serving meals in passenger planes was demonstrated in Los Angeles, Calif., the other day. Dishes that could not spill their contents or slip off tables while the plane made steep banking turns were shown.

The plates, cups, and glasses were held in place on tables by spring clips instead of wooden racks used in steamships for similar purposes. This is believed to be the first set of dishes designed expressly for airplane use.

Airplanes Move Artillery 120 Miles in an Hour

For the first time in history artillery was moved by the American Army in Panama by airplane. Pictures on this page show how the guns were put in the planes and carried across country 120 miles in sixty-seven minutes—a trip that formerly required four days. Below is a fieldpiece in position all ready to be taken aboard bomber.



Before this big Army bombing plane stands a howitzer, one of the guns that were placed in flying transport carriers and taken into the remote interior of the jungles of Panama.

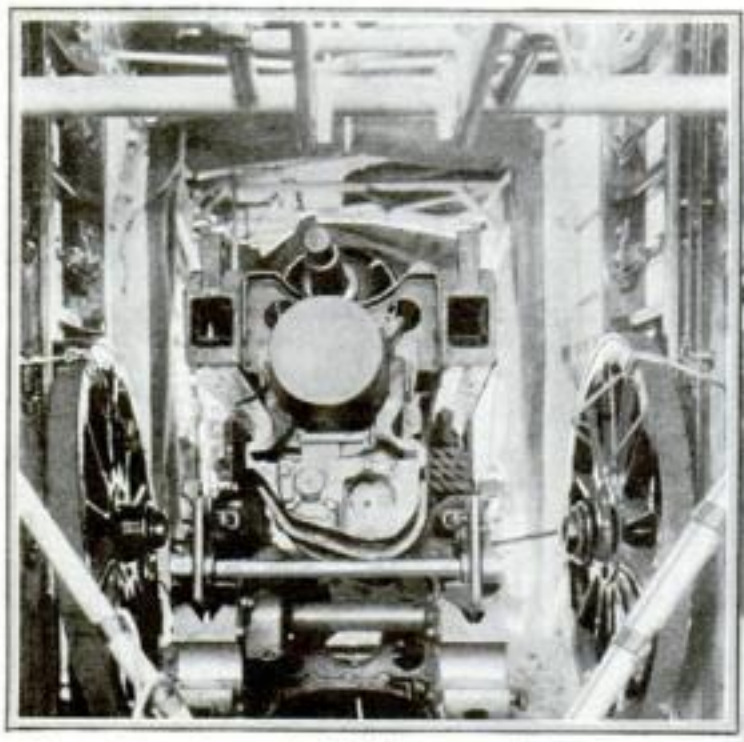
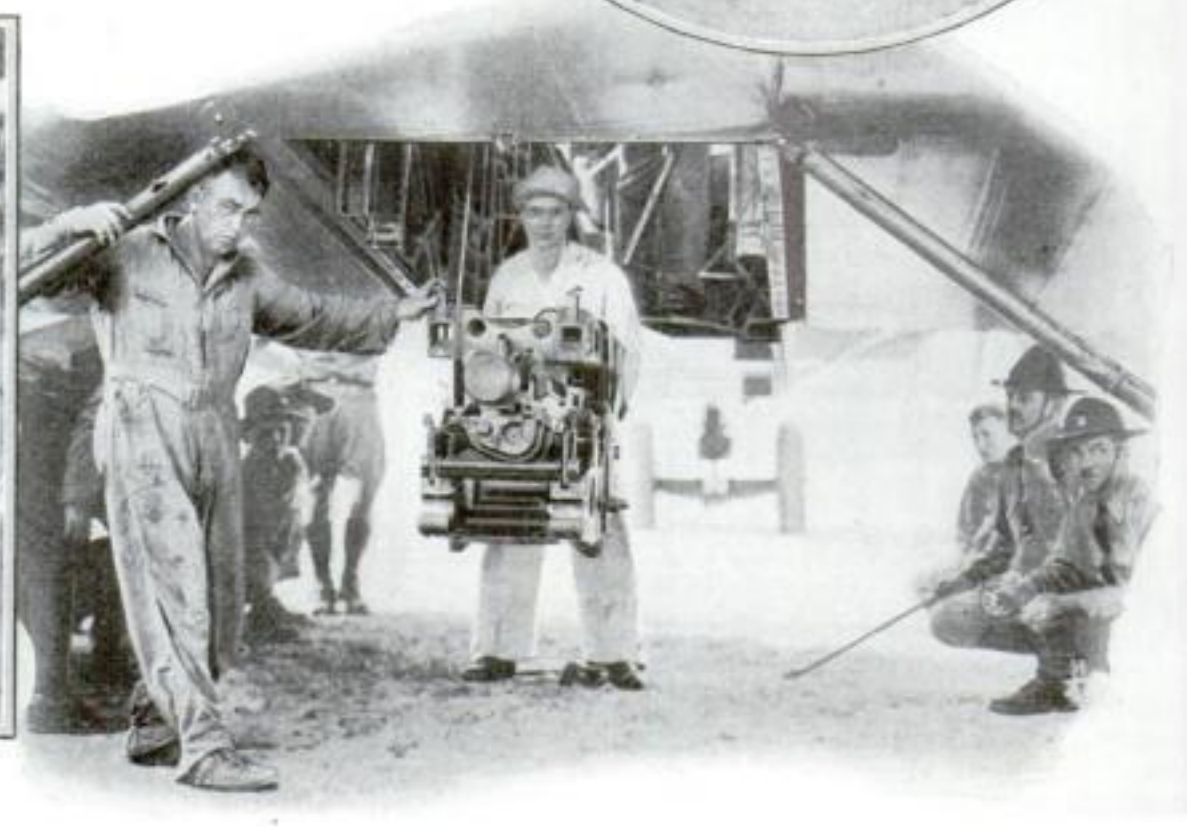


Photo above shows the fieldpiece stowed away in the bomber, with wheels securely fastened.



The big guns were partially dismounted as is shown above and then were hoisted into the fuselage of the plane. Three bombers, a Ford transport, and three Sikorskys were used.

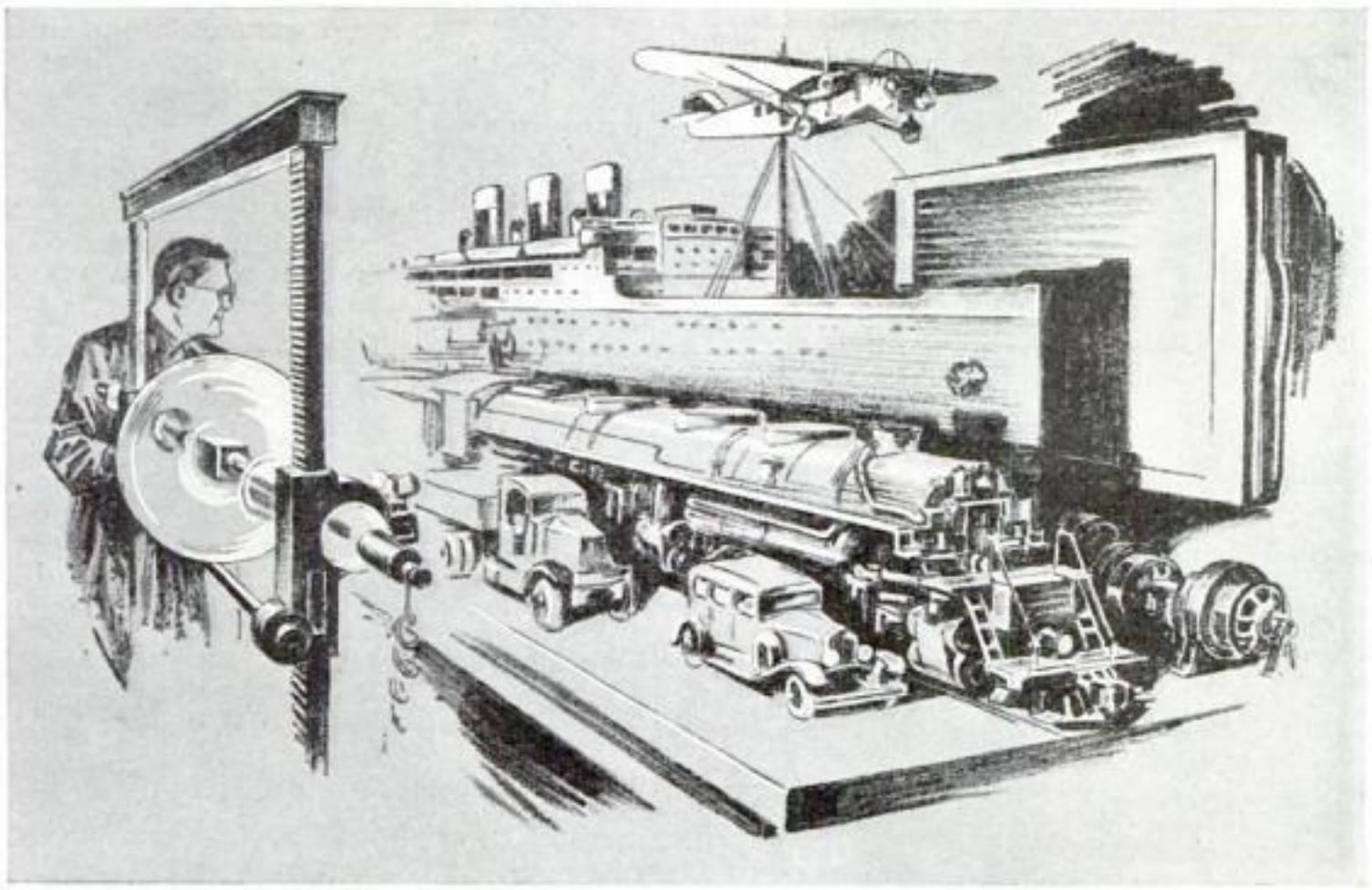
IT TAKES four days for an Army artillery battery to travel overland from France Field, Canal Zone, to the little town of Rio Hato in the Panama jungle, 120 miles away. But a complete field gun battery of four three-inch guns whizzed through the air the other day to make the trip in scarcely more than an hour. The remarkable demonstration, first of its kind in military history, showed how airplanes could rush batteries of artillery to strategic points to defend the Panama Canal in case of attack, as there are a number of suitable landing fields within a radius of 100 to 300 miles from the Canal Zone.

The fieldpieces, partially dismounted, were hoisted into the cabins of huge twin-motored bombing planes through trapdoors in the flooring. Three bombers, one Ford transport craft, and three Sikorskys made up the transport fleet, and fourteen speedy pursuit planes went along to protect them from a theoretical enemy. Just sixty-seven minutes after the start from France Field, the guns were unloaded, set up, and firing in their new location.

FIRST AUTOGIRO EQUIPPED AS SEAPLANE

Here is a picture of the first autogiro seaplane, built in England, where protracted tests have demonstrated its value. As it rises with a very short run, there is little chance for waves to buffet it before it gets into the air, an advantage in landing which this new type of aircraft also possesses over the present seaplane. It is understood that the autogiro recently ordered by the United States Navy will be similar in appearance to the one shown.

X-Ray New Watchdog of Safety



Mighty engines of transportation and tiny home devices are now inspected by X-ray.

Industry Uses Invisible Vibrations to Make Pictures of Insides of Giant Forgings or Household Utensils in Search for Flaws

By CLAYTON R. SLAWTER

MAGIC and a new factor of safety have been added to industry by the use of X-rays, those tiny invisible vibrations of ether so small that some have two trillion to the inch. Long the useful servants of the surgeon and doctor, X-rays now are making pictures of the inside of solid masses of steel and of the hidden parts of household utensils and showing, on photographic plates, weak spots in giant forgings—thus aiding in a new way in the protection of life, limb, and property.

Thirty-six years after its discovery, the curious paradox of the X-ray is as amazing as ever. Waves we can't see permit us to see into steel! In the laboratory, X-rays are produced by a hot wire filament in one end of a vacuum tube discharging electrons at a "target" in the other end of the tube. The electrons, jarring the target, cause it to give off X-rays. An everyday comparison is firing a gun at an iron plate. The bullet, representing the electrons, which are solid matter, strikes the plate and sends off a noise which, like the X-rays, cannot be seen and travels by means of waves.

Although our eye is incapable of distinguishing X-rays, they affect the sensitive coating of photographic film so we can take pictures of the interiors of solids, revealing any weak spots in their depths.

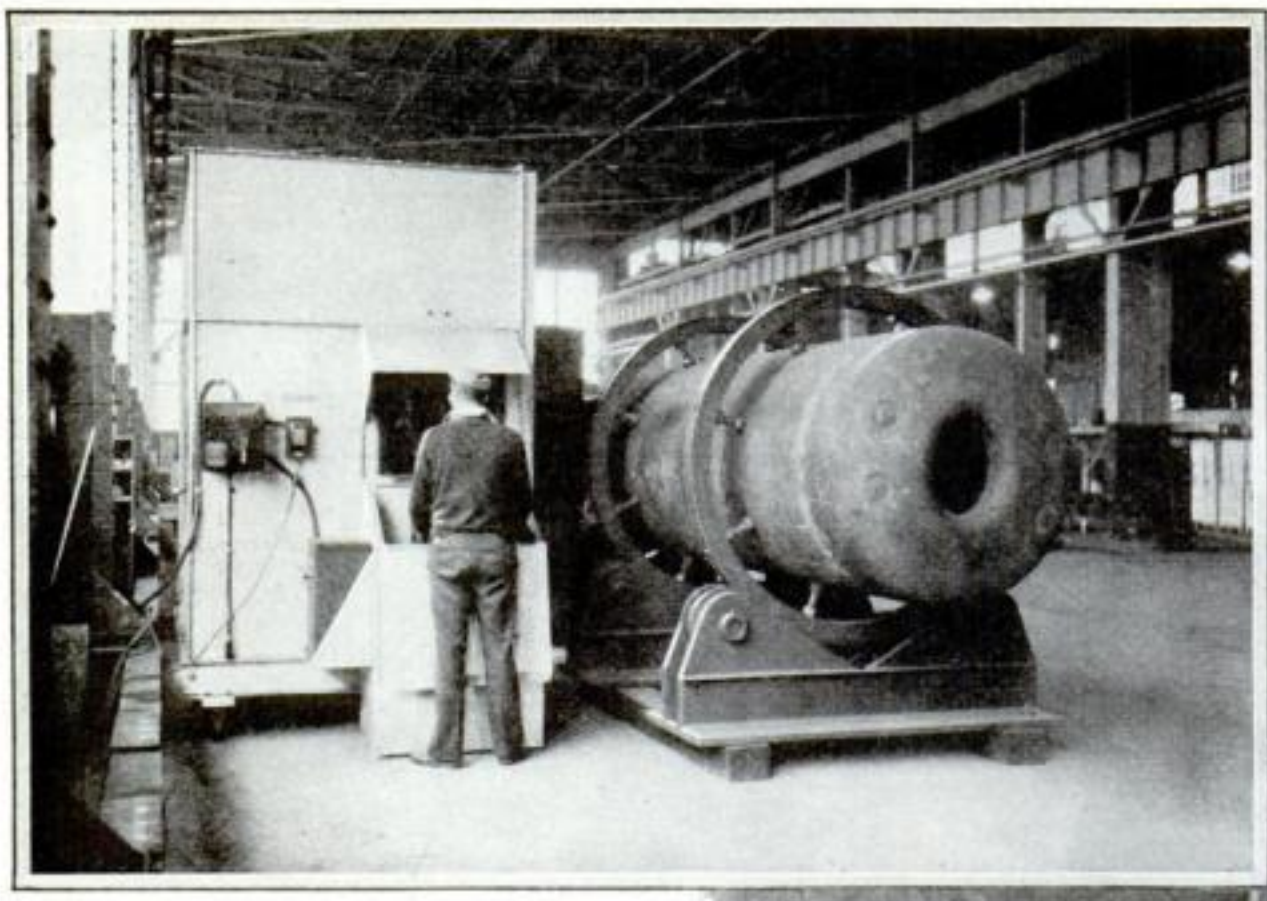
If you break open a loaf of bread, you find air pockets and cavities inside that are invisible from the outside. They are caused by air getting into the dough or by unequal strains on it as it is baked and cooled. Similarly, air pockets may form in the metal "dough" of castings or unequal strains in cooling may draw the metal apart, making cavities or weak spots within.

These are invisible from the outside. Only the magic of penetrating rays can reveal them. Consequently, laboratories in all parts of the country are now putting such rays to work, saving thousands of dollars and many lives each year.

One of the German State Railway's X-ray outfits which tests metal parts while in use. Here a bridge beam is being photographed.

THE other day I visited a workshop and saw how X-rays look through steel plates, iron castings, and great machine fittings that pass in file before the peering rays. The man in charge of the laboratory, Herbert Isenburger, New York industrial X-ray expert whose job it is to diagnose the ills of ailing metals, explained how the work is done.

Instead of an elaborate



At left of picture above is the X-ray metal testing apparatus, on wheels, in a boiler factory.

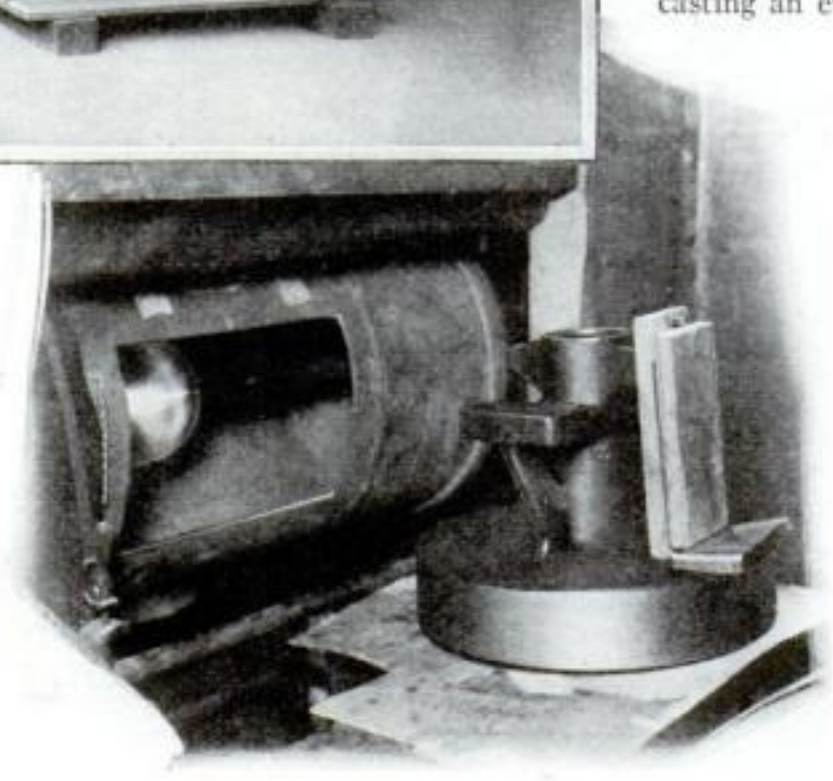
equipment, I was surprised to find that the photographs are taken on film merely clamped between two battered blocks of wood! This was placed behind the casting or engine part to be examined, which is mounted before a rectangular opening in a large lead-lined box standing in the center of the laboratory.

LEAD absorbs more X-rays than any other known material, so it is used to protect workers from injury by them. The thickness of the lead forming the walls of the box gives sufficient protection for the length of time required to make an X-ray photograph.

Going to a low cabinet resembling a lecturer's stand, Isenburger operated controls on its sloping top. Pointers on electric gages wavered like the feelers of strange insects; whirring machinery waked to life. A motor-driven rectifier, converting alternating current from high tension transformers to direct current for the ray tube, spun madly. Tiny arcs snapped between its whirring contact points. Reaching up to a cord overhead he tugged at it. Instantly a bolt of blue lightning snarled and crackled in the shadows of the ceiling. The X-ray had been put to work at its daily task.

"We have to warm up the tube gradually," he said. "When the current can jump that gap up there we know the rays can penetrate the depth of metal under examination. This machine works at two hundred and thirty thousand volts.

"What we are doing here is testing materials for engineering work. The piece I'm photographing now was designed for a large new power plant. If it goes into service, it'll have to stand a pressure of one thousand pounds against every square inch of its surface. I'm X-raying it to see if there are any hidden flaws inside. You can't take chances with pressures like that."



At left is seen the X-ray bulb in lead lined drum and at right are blocks holding film behind casting to be photographed.

HE showed me the arrangement of the apparatus. At one side of the big box is the power plant. On another side is a lead drum containing the X-ray tube. When the rays are working they are completely surrounded by this metal, which keeps them from scattering about the laboratory. A square opening permits them to pass into the lead-lined box in which the work is mounted.

ACTUAL taking of X-ray pictures, as it was explained to me, seems absurdly simple. They are used to make a "shadow picture" of the object under inspection. You can visualize this by painting a small piece of glass unevenly, with the paint thick and thin in spots. Now hold it up before a sheet of white paper in a strong light. You will see that the shadow cast by the glass is mottled, darker in some spots and lighter in others, according to whether the paint is thick or thin.

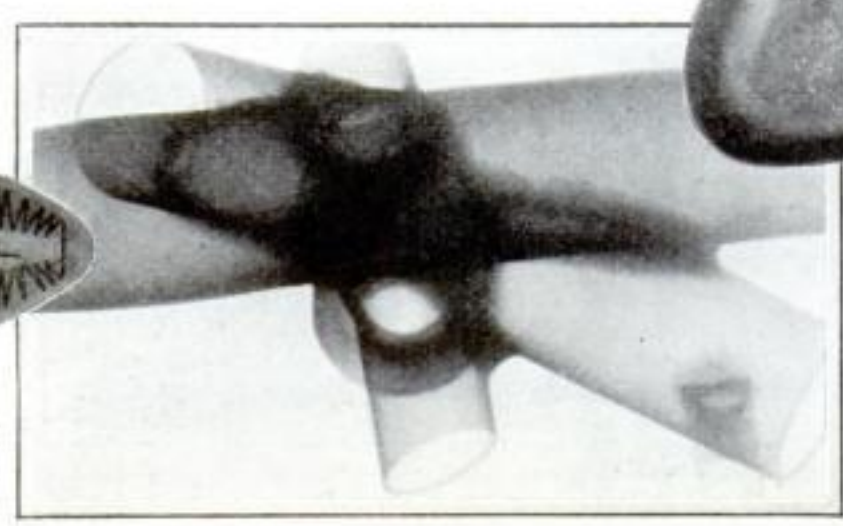
So a steel engine part is placed between the rays and the film. If its metal is sound the rays pass through it uniformly, casting an even dark gray shadow on the film. Should there be flaws or cavities in it, more rays will pass through at those places, making light spots on the film, just as you saw the mottled shadow of the glass plate. The picture of the casting I saw being photographed showed such spots when it was developed.

Imperfections such as these spots represent would, in many of the parts used in engineering work, be a serious menace to life and property if undetected.

The piece I saw X-rayed could be carried by one man. Yet it was made to sustain a pressure equal to the weight of a large locomotive. Failure of the part under a pressure like this would be as destructive as the blast of a high-explosive shell.

Industry has given X-rays a big job that is daily growing bigger. On the German State Railways, for example, two odd-looking trains are in continual service. They are completely equipped traveling X-ray laboratories. At different points on their runs they are used in examining locomotives already in service. Flaws in driving-wheel *(Continued on page 143)*

X-ray picture of an assembled flat-iron. Here the rays found no flaws in the heating element, proving the iron perfect when it left factory.

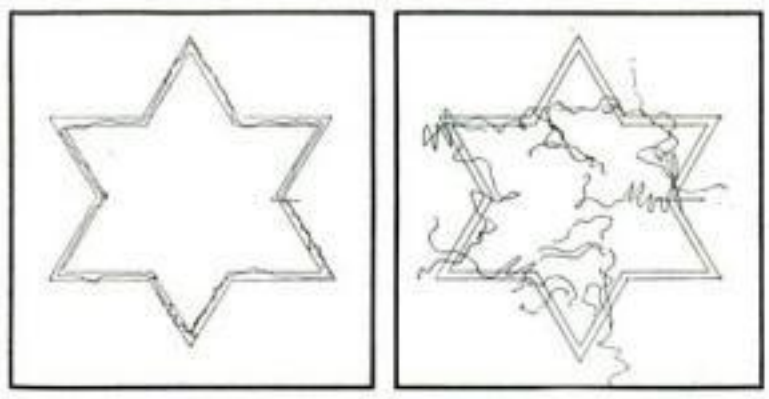


This aluminum frying pan is far from perfect, as the X-ray photograph clearly shows. The white spots indicate flaws which the eye cannot find.

At left is an X-ray picture of the joint in the fuselage of an airplane. The absence of white spots proves there are no defects in this particular casting.

Brain Tests Keep Crooks in Line

Dr. J. Q. Holsopple, left above, is giving a criminal the mirror-drawing test in which he must change his usual writing method.



Stars drawn by prisoners from mirror images. Man who drew ragged one at right probably could not reform.

By JOHN E. LODGE

Among the hundreds of tests given to criminals by Dr. Holsopple is this one in which the man is required to fit pegs into holes of various shapes and sizes. His ability to do this gages his mentality.

IN THE world of crime, sheep can now be separated from goats. Sheep are those who can and will reform. Goat crooks are those who can't and won't.

New Jersey state experts, wise in the ways of a crook, have given 10,000 mental tests to jail and reformatory inmates during the past two years. The tests were made under the direction of Dr. James Q. Holsopple, formerly of Yale University, now chief clinical psychologist of the New Jersey State Department of Institutions and Agencies—a job he has held since 1928.

The tests proved that the man who sneaks into your yard at night and steals a chicken and the bandit who stages a daylight bank robbery and "shoots it out with the cops" essentially have the same mental make-up.

It was found that almost all criminals have four traits in common: They have little if any control over their feelings. Often they are not quite bright, though seldom feeble-minded. They act quickly upon suggestions without considering the consequences. They are unable to tell the fine points of difference between one situation and another.

A fifth trait, shared by many but not by all, is the inability to unlearn what once has been learned; in other words, the inability to shake off old habits of thinking. The fact that some have this trait and others not probably is the most important point brought to light by the tests. For this is where the main difference comes in between a goat and a sheep.

TO FIND out to which class each prisoner belongs, all are given the "mirror drawing" test. Each is made to trace a six-pointed star with his hand shielded and a mirror placed so that he watches the tracing in the glass. This forces him to make every movement backward. To succeed, he must break his old habits of drawing and writing. Those unable to do this find it hard to change their habits of living. When released from prison and sent into the world, they are likely to return sooner or later to a life of crime.

The results of the psychological tests now are taken into consideration by officials in parolling prisoners. The records justify the psychologists. Fewer violations have been reported since paroles have been granted in this way.

Recently, Dr. Holsopple examined a tottering old man, nearly seventy, who had spent forty years of his life in various jails. He was a petty burglar. Asked if he would like to be transferred to the prison farm and spend his remaining years in comfort, he declined. "No," he said. "I want to serve my sentence and then get out. This time I'm going to make good."

He had said that probably a thousand times before. But each time he had received a parole or finished a sentence, he had drifted back into his old ways. His failure to pass the mirror test checked with his history. He was a hopeless "repeater."

Another cause of parole violations is emotional instability. Those who are quick-tempered, easily angered, easily amused, are likely to violate a parole. They act without thinking. They may kill a man simply because he calls them names. Most men in prison for sim- *(Continued on page 149)*

Here is another test that uses the pegs in strange holes. The erratic and subnormal fail completely at this test.

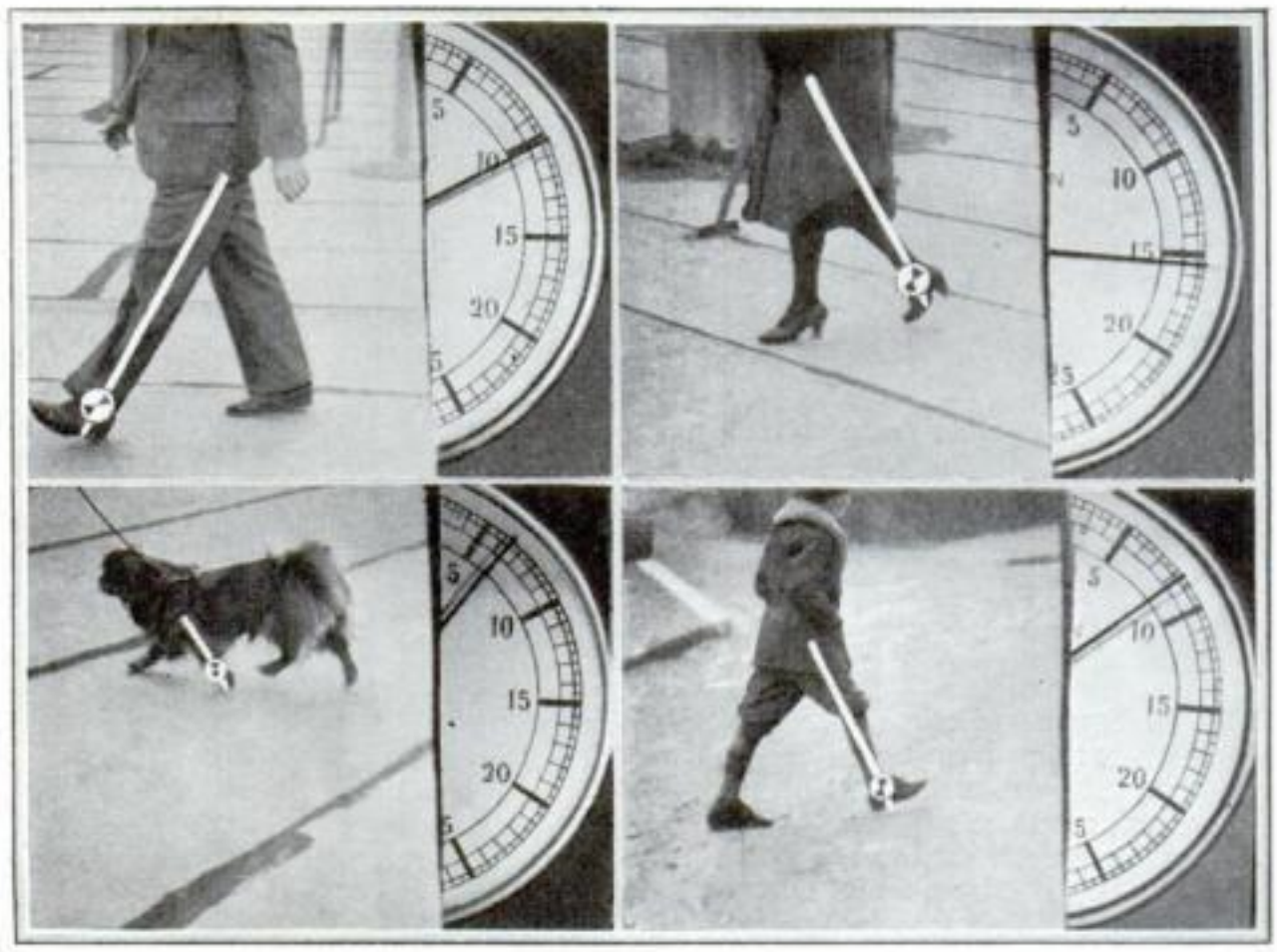
Tests with Movie Camera Prove That

Our Legs Are Pendulums

Do you know that laws of mechanics set a limit to the length of stride you can take and the speed at which you can walk? Use of movie discloses locomotion secret and shows why you run faster than walk.

By

GAYLORD JOHNSON



Pictures of a man, girl, boy, and dog, their walk synchronized with the second hand of a clock, were made to prove that the leg moves like a pendulum and is governed by the same law of mechanics.

WALK along the street at your natural, brisk pace, watch in hand, and count your steps for exactly a minute. If you are of average height, the number will be a few more or less than 120, or about two steps a second.

Now count the steps of some man about your height who is walking ahead of you, but count only the heel strokes of one of his legs. These will be approximately sixty, or one complete backward and forward swing of the leg in one second.

The leg of a walking man of average height therefore seems roughly equivalent o a clock pendulum which vibrates to and fro in a second. In other words, it beats half-seconds.

If you have observed pendulum clocks of various sizes, you know that the tall grandfather kind swings slowly, while the shorter wall clocks swing much more quickly. To watch a grandfather and a wall clock ticking side by side in a jewelry store inevitably suggests the long stride of a grown person and the short, quick stride of a small child. The grandfather's pendulum beats seconds, and a wall clock's half-seconds.

IF YOU should go to the trouble of measuring and comparing the lengths of the pendulums in a grandfather and a wall, you would make a very interesting discovery. It is this: while the wall clock's pendulum swings twice as many times per minute as the grandfather's, it is only one fourth as long. The average length of a wall clock's pendulum is 9.75 inches; that of a grandfather clock is thirty-nine.

When this relationship of a pendulum's length to its time of swing is put into a concise statement, it is called "the law of the pendulum," as follows:

If one wishes to make the vibration time of one pendulum twice that of another, he must make its suspension four times as long. Or, one might say, the lengths are to each other as the squares of their times.

LET us apply this to our wall and grandfather clocks and see how well it holds true. The grandfather executes one beat per second, or sixty per minute. This number squared is 3,600. The wall clock does 120 beats per minute, the square of which is 14,400. Since 14,400 is just four times 3,600, the grandfather clock's pendulum must be four times the length of the wall clock's. It holds true, for thirty-nine is four times 9.75.

Now it will be interesting to examine and compare the rates of walking of a man, a child, and a small dog, and so see if the ratios of their steps per minute to the lengths of their legs obeys the law just established for the clocks.

The writer undertook to prove this using a motion picture camera to make the counting and comparison of the steps accurate and easy.

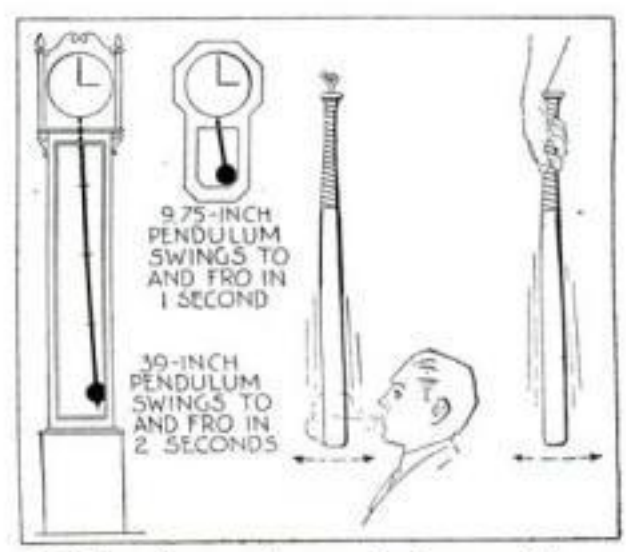
In order to determine in advance the exact number of pictures taken per second by my motion picture camera, I proceeded as follows:

I first prepared a black cardboard "mask" for the picture frame of the camera. This covered up all but one quarter of each picture to be taken. Then, with the camera on a tripod, I focused the image of a second-timing clock's dial in the exposed quarter of the picture frame, and ran through several strips of film with the clock running. The moving hand was photographed, on each strip for ten seconds.

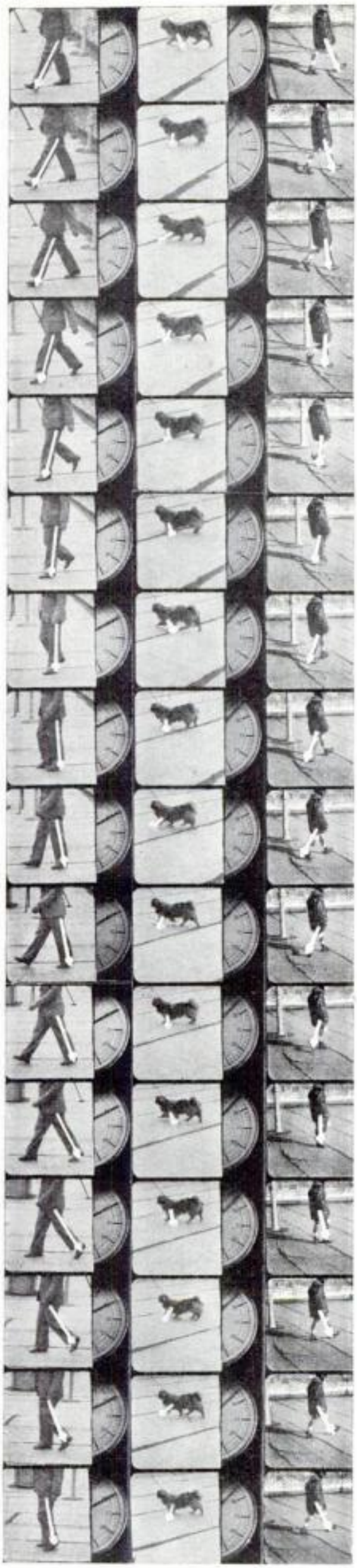
On developing one of these strips, I found that 160 pictures had been taken while the second hand was moving over the ten spaces. This proved the camera's speed was sixteen pictures per second.

The remaining undeveloped strips of film were then reloaded into the camera's magazines, and the side of the frame through which the clock's dial had been photographed was blocked up by a strip of black card, while the rest of the picture area was opened up for photographing the man, child, and dog whose leg motions were to be studied.

After these pictures had been developed, the clock dial showed in each frame beside a picture of a walking subject, and comparison of the successive positions of



Relation between long and short pendulum. Right, why it's hard to increase swing rate.



The sixteen photos of each strip show that in man, child, and dog the rapidity of stride in walking is controlled by law of gravity.

Obeying law of pendulum, short-legged runners, above, make better sprinters while those with long legs take prizes in distance running.

the second hand with the leg positions indicated the number of steps taken per second by man, child, and dog.

The results are shown by the three parallel strips of film reproduced at left. Each strip includes sixteen pictures and shows the number of pendulum swings made by each kind of leg in one second.

If legs are really pendulums, the number of steps per minute taken by any two legs (say the man's and the dog's) should compare with their respective lengths in the same way as the number of beats and lengths of the clock pendulums did.

In the case of this particular man, his leg completed 1.95 steps in one second, equivalent to 117.3 steps per minute. The little Pekinese dog's leg completed 5.5 steps, equal to 333.5 steps per minute.

The man's leg, from sidewalk to hip joint, measured 35.37 inches; while the little dog's foreleg measured 4.25 inches. The former is about 8.31 times as long as the latter. If the legs obey the law of the pendulum, the square of 333.5 divided by the square of 117.3 should be approximately 8.31. Let us see if it is.

THE square of 333.5 is 111,250; the square of 117.3 is 13,753. The first divided by the second gives 8.08, which is correct within natural limits of error.

Why is this the case? You can answer the question for yourself by making a simple experiment. The normal pendulum rate of your leg is, let us assume, 120 steps a minute. Suppose you try, in any way you like, to walk half again as fast, or at the rate of 180 steps a minute. You will find that your utmost efforts at faster walking will only increase your rate by about fifteen percent. You may try to better this either by taking longer strides or shorter, quicker steps, but you cannot add more than this definite percentage to the frequency of your leg-swing unless you begin to run.

The reason is that the mechanical design of the human body was planned to economize work, and Nature has, you may say, discovered that walking can be accomplished most easily when the force of gravity is allowed to do a large part of the work. In other words, when the leg moves as nearly as possible at the same rate as a pendulum of similar proportions when swinging freely.

TO ILLUSTRATE. If you put a screw eye in the end of a baseball bat and hang it on a nail driven in the edge of a shelf, you can start the bat swinging in its natural pendulum time by merely blowing periodically on the lower end. But if you wish to make it swing half again as fast, you must take it in your hand and exercise considerable force.

This explains why sprinters who must cover short distances at the highest possible rate of speed are seldom very tall men. Their short leg-pendulums, being built to swing most easily at a large number of steps per minute, give maximum speed for the muscular energy expended. Rapidity of the steps in a 100-yard dash is more important than their length.

But in a distance runner's work the requirements are quite different. When the race is a mile or more, the advantage is with the long-legged man who can cover the distance in the fewest strides.

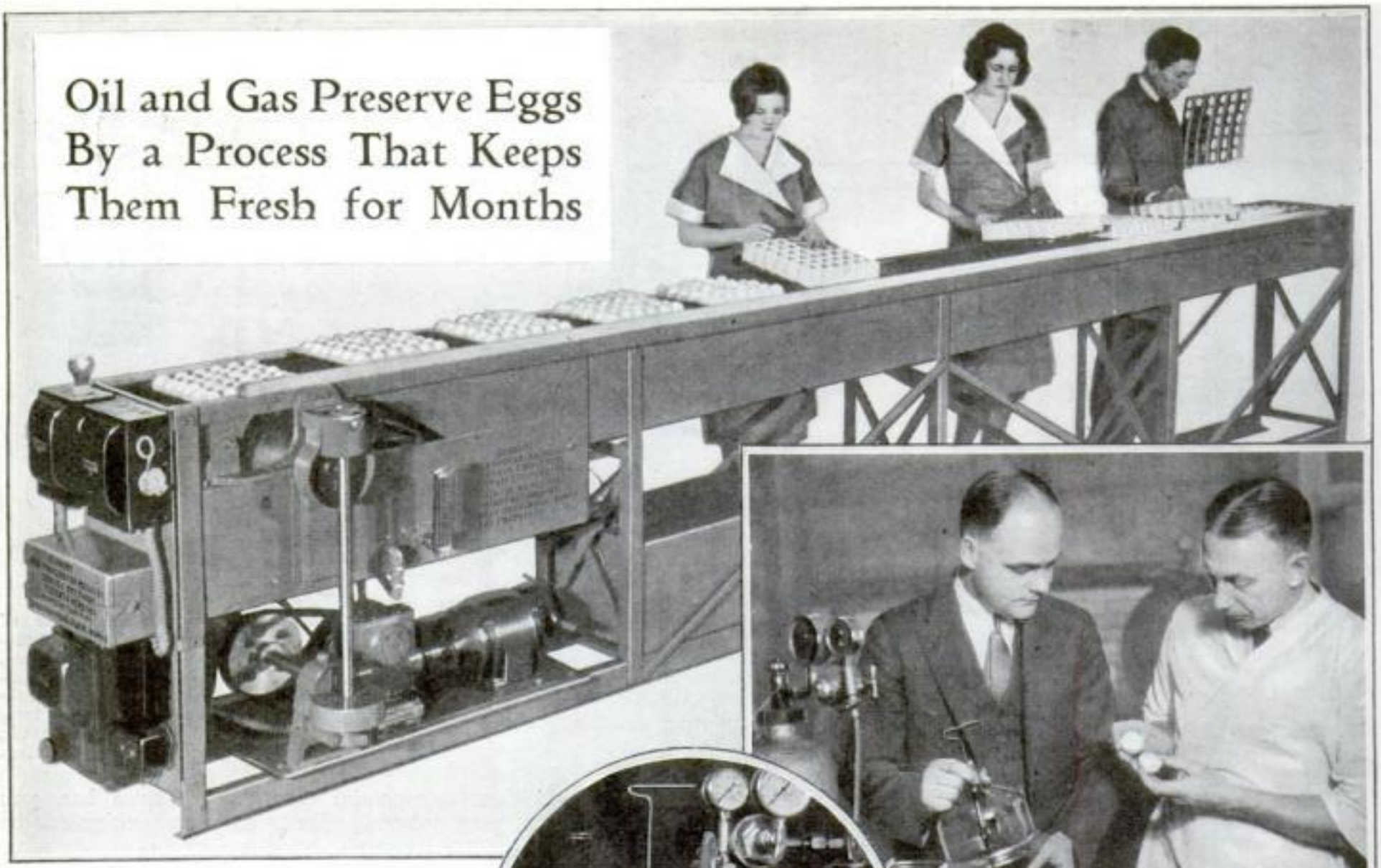
We have one more point to cover: the reason why a run is faster than a walk.

We run with greater speed than we can walk mainly because the forward swing of our legs is made with their pendulum length much shortened.

Another reason for the greater speed of running is that the foot strikes the ground on the ball rather than the heel, thus adding considerably to the length of the lever which is used to thrust the body forward.

The lengthened stride that results from this leap, together with the exceedingly rapid forward movement of the leg (made possible by the shortened pendulum) shows how Nature has taken full advantage of a simple mechanical principle in enabling man to increase his pace when necessary.

Oil and Gas Preserve Eggs By a Process That Keeps Them Fresh for Months



In this new electric machine the eggs travel on an endless belt into a hot oil bath.

Left above, T. L. Swenson, of the Department of Agriculture, inventor of oil bath for eggs.

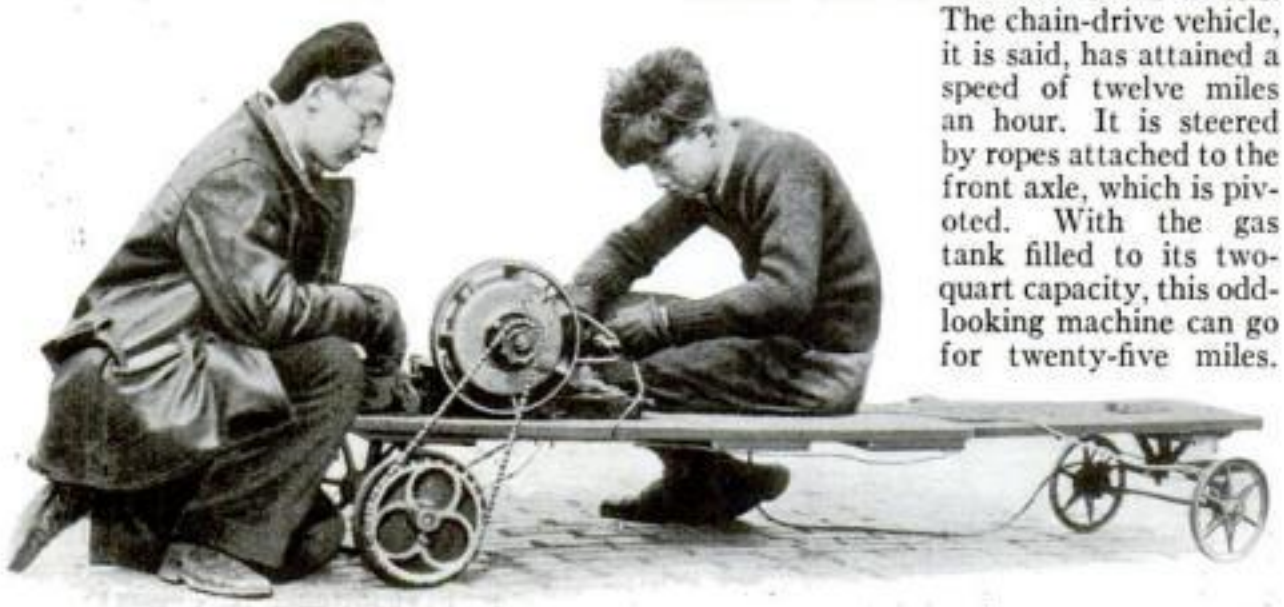
Experiments with this vacuum jar proved that carbon dioxide improved oil treatment of eggs.

BY ADDING "gassing" with carbon dioxide to a new oil treatment for the preservation of eggs, T. L. Swenson of the United States Department of Agriculture has greatly improved the process. Indeed it is predicted that the commercial application of egg "gassing" will make strictly fresh grades as cheap in midwinter as in summer.

For some months Western egg handlers have been dipping eggs in tasteless mineral oil to improve their keeping qualities. Now Swenson has discovered that by applying the oil in a vacuum and then allowing carbon dioxide gas to enter the chamber, a fine film of oil is formed between the hard outer shell and the soft inner skin. This seals the egg against the loss of natural moisture or of the excess carbon dioxide gas absorbed in the process. It is the gas that acts as a preservative of the eggs.

WASHING MACHINE MOTOR RUNS HOME BUILT AUTO

Two Pittsburgh, Pa., youngsters are the proud possessors of an auto they built themselves. Joe Smalley and Don Graham recently got an old washing machine gasoline motor which they installed in a "chassis" built of boards and old wheels. The chain-drive vehicle, it is said, has attained a speed of twelve miles an hour. It is steered by ropes attached to the front axle, which is pivoted. With the gas tank filled to its two-quart capacity, this odd-looking machine can go for twenty-five miles.



These two Pittsburgh boys built the scooterlike auto shown here from boards and old wheels and powered it with a washing machine motor. It can make twelve miles an hour.

MAGNET PICKS UP CAR PARTS FOR MECHANIC

CAPABLE of picking up two pounds of metal, this magnet is made primarily to aid the auto mechanic in picking up metal cuttings, broken pieces, and nuts and bolts. It can be inserted into the transmission to remove bits of metal, and it can be used to insert bolts and screws where the hand cannot reach. It is an electromagnet.

With this long-handled magnet, capable of lifting two pounds, mechanics pick up parts.

AIR FILTERED BY PAPER IN NEW VENTILATOR

A WINDOW ventilator that strains dust and noise from air as it enters a room is a new development of a Chicago, Ill., manufacturing firm. Windows are partly raised and the throat of the device, slipped into the opening, completely fills it.

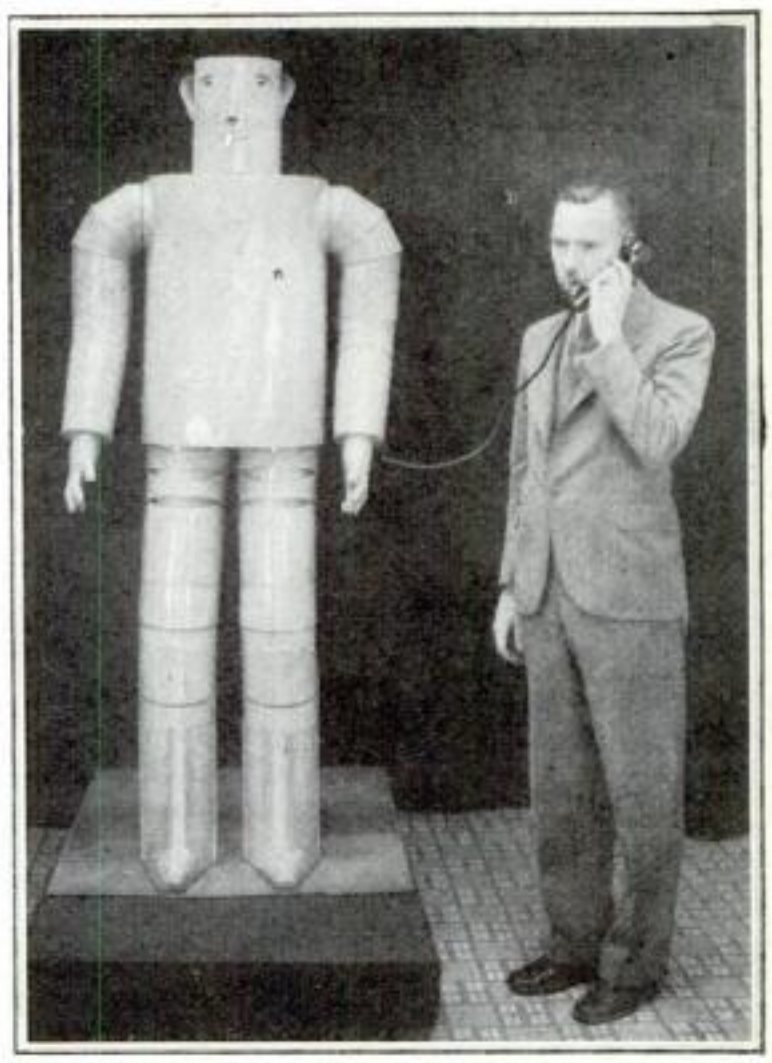
A motor-driven fan sucks air through this and discharges it into the room through a paper screen filter. Filter paper can be changed in a few seconds of time. The motor and fan, in a small cabinet, stand on the floor below the window to which the apparatus is applied. Homes, offices, and hospitals can use the device.

ELECTRIC MAN OBEYS MASTER'S VOICE

A REMARKABLE mechanical man was put on exhibition in St. Louis, Mo., the other day. Unlike earlier devices of this kind, which only obeyed whistled signals, "Mr. Vocalite," the new iron man, responds to words of command spoken into a telephone mouthpiece.

This robot, developed by J. M. Barnett, a Westinghouse engineer, can sit down and stand up, talk, sing, smoke cigarettes, and perform various duties like turning on electric lights, ranges, and vacuum cleaners.

Electrical impulses of spoken orders are carried to the robot's "brain" on beams of light that a photo-electric cell translates into electricity and motion.



This new mechanical man, equipped with electric eye, will do a number of things in response to human voice.

TO STUDY EARTH WITH DYNAMITE

HARVARD University scientists plan to use dynamite as a yardstick in measuring deposits of gravel and earth left by glaciers that once covered large parts of the North American continent.

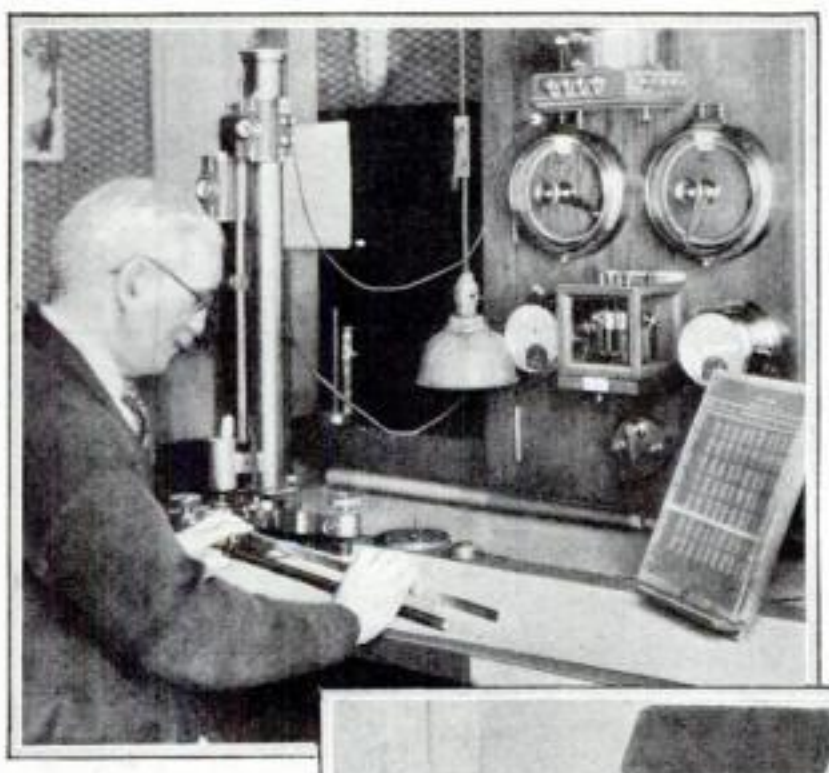
Shots of the explosive will be set off at varying distances from a portable seismograph. The time taken by tremors of the explosions to be registered on the instrument will enable the scientists to calculate the thickness of the earth's crust down to bedrock. This method of measuring the depth of rock already has proved of value in prospecting for minerals and oil.

BRAKE TESTER SHAPED LIKE DRIVER'S LEG

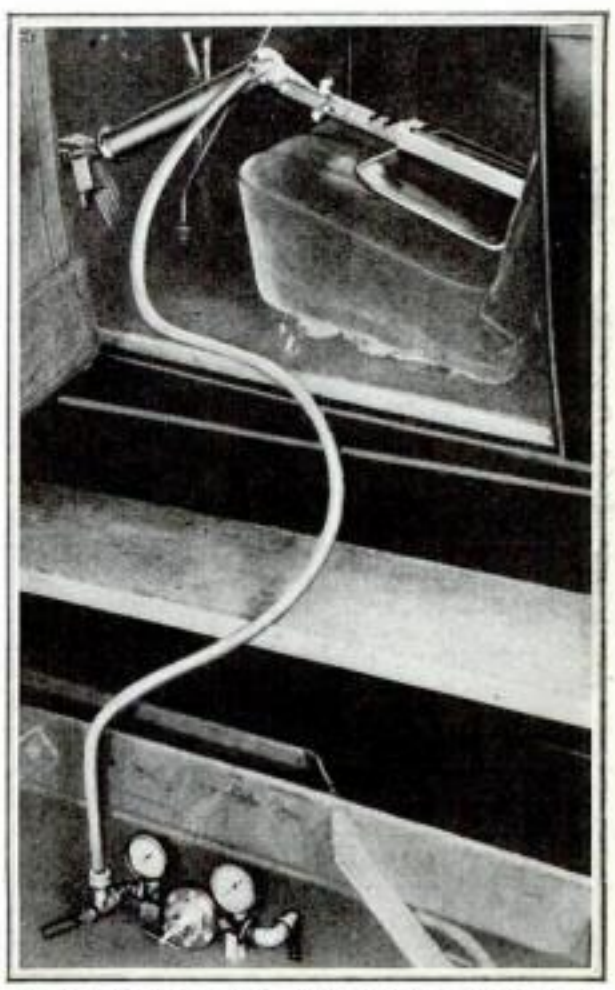
FUNCTIONING as the motorist's leg does in exerting pressure on an automobile brake, a pedal pressure measuring device has just been brought out by a brake testing machine manufacturer. Adjustable for angles and length, it is operated by compressed air and is equipped with gages that tell the number of pounds pressure and so record the amount of pedal push.

FALLING ROD GIVES TIME OF GUN SHOT

How long after you pull the trigger does the charge of shot come out of the muzzle of your gun? Twenty-five to thirty-five 10,000ths of a second, say gun experts who calculate this speed from tiny scratch marks on a metal rod falling through a hole in a bench. An electromagnet releases the rod when the hammer falls and an electrically operated knife nicks it as the shot leaves the muzzle. The time is calculated by measuring the nick's distance from the end of the rod.

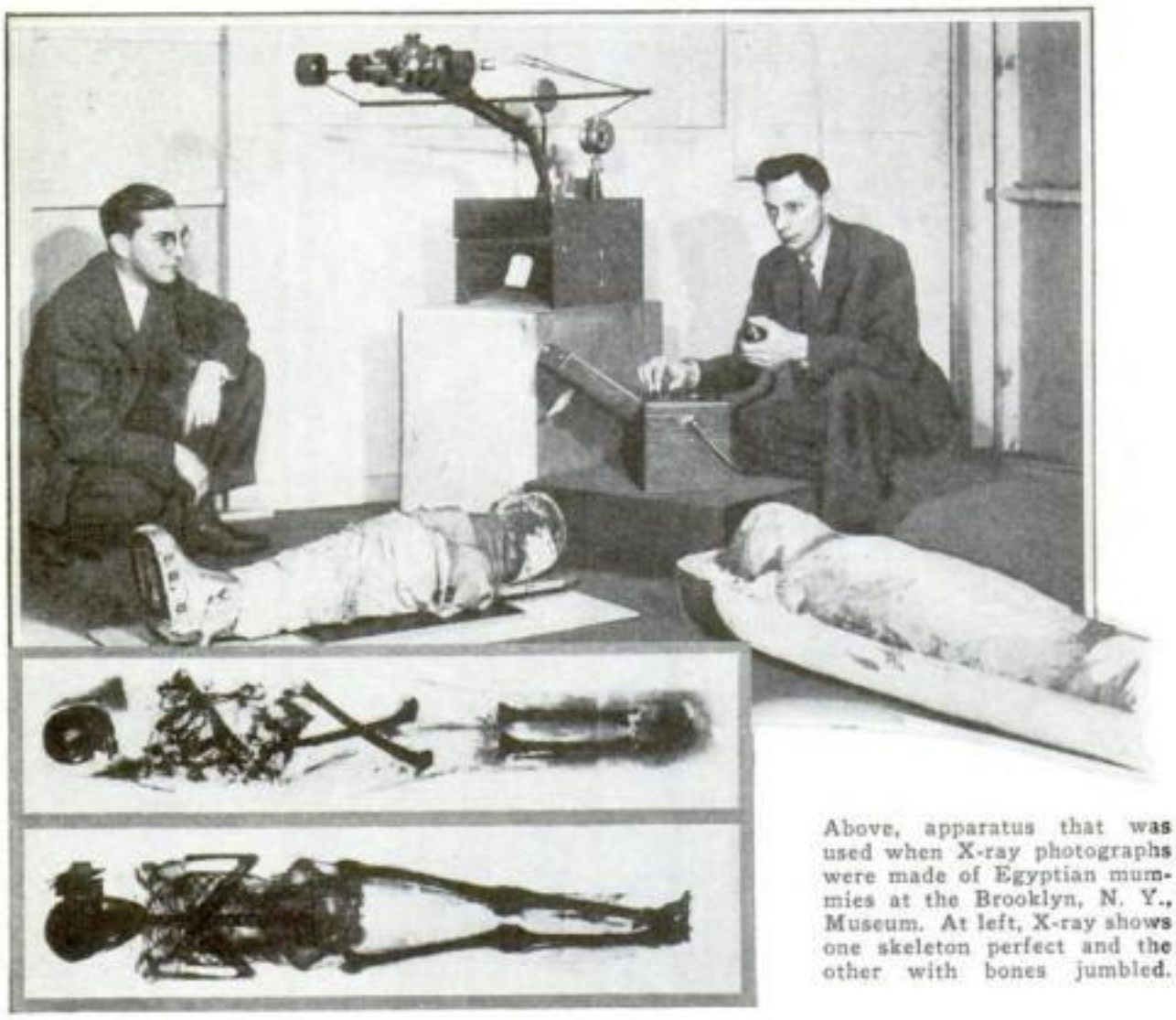


With this falling rod chronograph operated electrically, time of shot from hammer to muzzle was measured. At right, preparing to fire a shot with mechanism in readiness to record time interval.



Attached to pedal, this device shows on dials the pound pressure needed to set brakes.

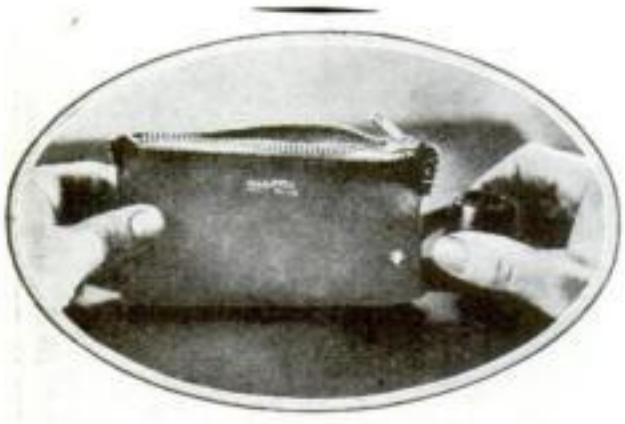
X-RAY DISCLOSES MUMMY'S SECRETS



Above, apparatus that was used when X-ray photographs were made of Egyptian mummies at the Brooklyn, N. Y., Museum. At left, X-ray shows one skeleton perfect and the other with bones jumbled.

EGYPTIAN mummies at the Brooklyn Museum in Brooklyn, N. Y., were examined by a new method the other day when X-ray photographs were made of them. In this way, many interesting facts were discovered. One of the mummies, that of a woman, was found to be in perfect condition. Not a bone was displaced, and the cause of death could not be seen.

Photographs of another mummy showed most of the bones were displaced and some of the small ones missing. It is assumed that embalming took place long after death, when nothing but a skeleton remained. Evidence of a violent death were found in the mummy of a small child. Its skull was fractured.



NEW TOBACCO POUCH HAS ROOM FOR PIPE

A NEW type of leather tobacco pouch holds both tobacco and a pipe of ordinary length. The pipe fits into a separate compartment at the bottom of the pouch, and is held in place by a strap fitted with a snap button. The tobacco is removed from the top of the pouch, which is closed with a zipper fastener. The whole thing fits easily into the pocket, and is intended to keep the pipe where it can be found when wanted. The pouch holds the usual amount of tobacco.

TEST AIRPLANE ENGINES ON MOUNTAIN TOP

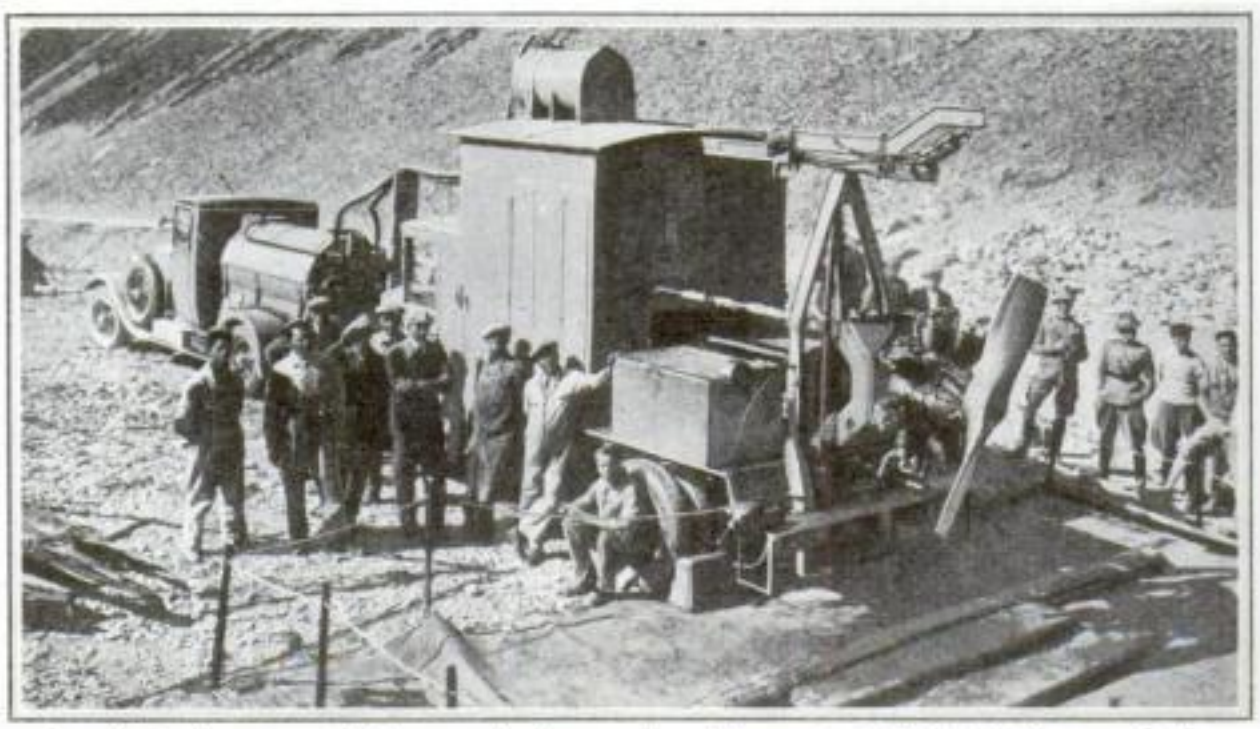
HIGH altitude tests for airplane engines made while they remain on the ground is the novel idea of an Italian firm of airplane engine builders. In testing a new or overhauled motor, it is mounted on a large auto truck and taken to the top of a high peak in the Italian Alps, 10,000 feet above sea level.

There in the rarefied air it can be run under actual flying conditions. For test purposes it is secured to a framework at the rear of the truck, while instruments for measuring its performance are housed in a cabin at its center. It is claimed that testing an engine to determine the effects of altitude and cold in this manner is more accurate and less costly than the usual way with low-pressure chambers.

"HOT PAPA" PROTECTS LIFE OF NAVY FLYERS

"HOT PAPA," least-known member of Uncle Sam's Navy, recently posed for his picture aboard an aircraft carrier. Few outside the service knew of his existence until it was revealed during the recent Panama maneuvers (P.S.M., May '31, p.70). But to the pilots on the three Navy carriers, the *Saratoga*, *Lexington*, and *Langley*, he is an important person.

Otherwise known as "the asbestos man," he stands all day near the landing decks of the three carriers, dressed in a complete suit of asbestos. He has only one job. That is, if a plane should crash and burst into flames, to dash in and drag the pilot to safety. Extinguishing the fire is a secondary consideration. The first is to save the pilot. "Hot Papa," who was named by the carriers' crews, has not yet been used in his official capacity.



In order to know exactly how an airplane engine will operate at high altitudes, an Italian manufacturer now takes the motor on a truck to a high mountain to test it in rarefied air.

STAINLESS STEEL SPOKES SNAP ON AUTO WHEELS

WIRE wheels of an automobile can be brightened up by application of shiny metal sleeves fitted over the spokes. These coverings, the product of an automobile wheel manufacturing firm in Detroit, Mich., are made of bright steel that will not rust or stain.

They do not completely cover the spokes, but merely inclose the outer parts of them. Having a C-shaped section they are snapped in place, needing no screws or clips to secure them. Since they hold themselves firmly in place there is no looseness and consequent rattle when they are applied to a car. They are not designed to strengthen the wheel but primarily are intended to enhance the appearance of the car.

ENGLISH NURSES DRILL IN GAS MASKS

Members of a British Red Cross unit are now required to wear their gas masks while practicing a first-aid drill. This is done to accustom them to the manner of breathing while thus equipped.

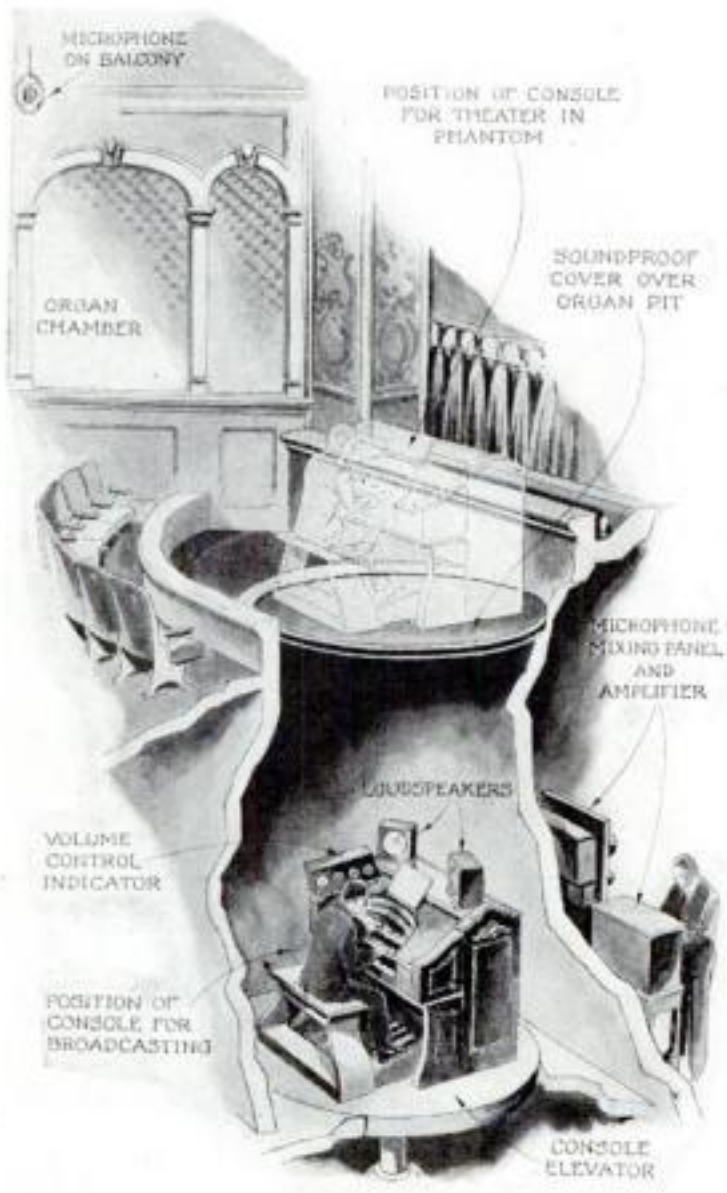
GROTESQUELY attired, members of a British Red Cross unit carry out first-aid drills in gas masks. They have been ordered to wear their masks so they may become accustomed to breathing in them while doing hard work.

Both nurses and stretcher bearers complete all the evolutions of their drill wearing the anti-gas devices just as they would in an emergency. All members of the unit, it is said, have greater confidence in their equipment as a result of this regulation, and do their jobs more readily through familiarity with the device.

NEW NORTH RECORD SET FOR MONKEYS

FARTHEST north for the monkey tribe is believed to have been claimed by a species that once, far earlier than history records, inhabited what is now Holland. Fossil remains recently discovered in that country show these monkeys to have been similar to those now found around Gibraltar, although somewhat larger. Scientists believe the fossils found in Holland indicate that a mild climate once existed there, as monkeys cannot endure cold.

ORGANIST NOW HEARS HIMSELF ON AIR



How the console of a theater organ is lowered into a soundproof pit so organist hears radio broadcast.

BROADCASTING organ music from a soundproof pit is a new stunt worked out by Vernon A. Trigger, chief engineer of radio station WBZ, Springfield, Mass. Hitherto organists have been unable to hear their own broadcasts and as a result have found it difficult to play in a way that will meet the peculiar requirements of the air.

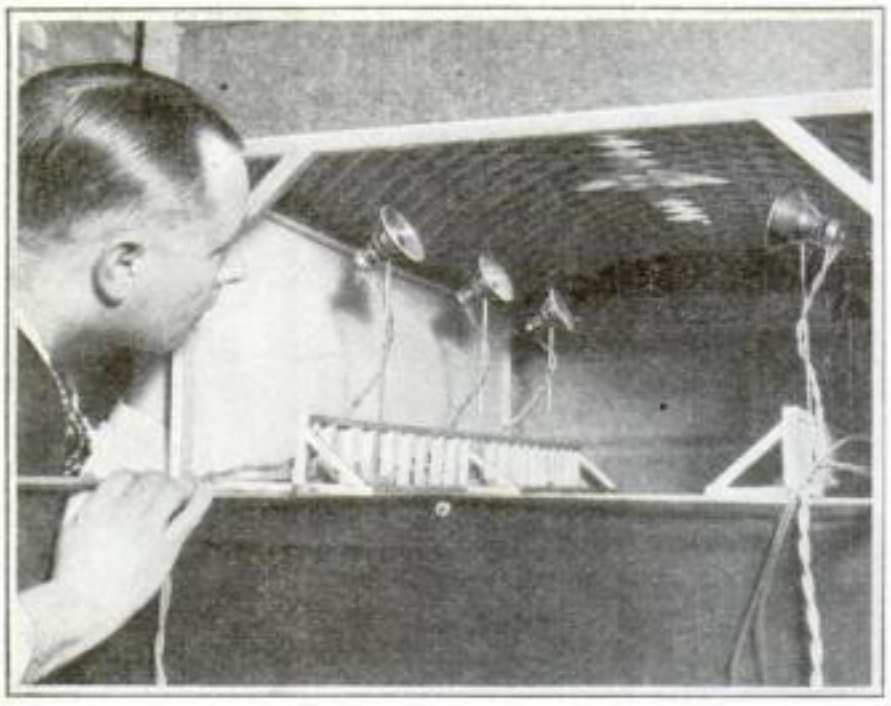
Trigger's scheme mounts the organ console on a hydraulic lift which, before the broadcasting starts, lowers the console into a pit, the top of which is then closed with a felt covered board, thus making it soundproof. In his pit, the organist is out of range of the sound chamber of the theater. He does not hear his playing as the theater audience does, but as radio listeners do.

Two loudspeakers and a volume control indicator are set up with the console which enable the organist to listen in on his own broadcasting. Diagram at the left shows the organist in the ordinary position while playing for the theater audience and also when lowered to the bottom of the pit for broadcasting. It is expected that true tone color can now be given to organ recitals. The cost of installation probably will set a limit to the number of stations that will be equipped for this kind of organ broadcasting.

GIANT ELECTRIC LIGHTS FOR NORTH POLE SUB

WHEN Sir Hubert Wilkins' submarine *Nautilus* plunges under the Arctic ice cap on her voyage to the Pole this summer, she will not be entirely blind. Two huge electric headlights, of 1,000,000 candlepower each, will cast beams of light nearly 100 feet ahead of the vessel. The lamps were tested to a pressure of one hundred pounds to the square inch.

Sir Hubert Wilkins, right, inspects the electric lights that will guide his Arctic "sub."



MODELS USED TO STUDY WORLD FAIR LIGHTING

ENGINEERS in Chicago, Ill., are experimenting with different lighting effects to be used at the World's Fair which will be held in that city in 1933. When it is finally opened to the public, the visitor will see light used for decorative purposes on a scale never before attempted.

Both inside and out, buildings of the fair, resembling some fabulous dream city, will be a blaze of stationary and moving colored light. Tests now being made with scale models of the buildings, one of which is shown above, show lighting engineers what combinations of color and movement are best suited to each structure.

BREAD PAN BASE FOR ULTRA-VIOLET LAMP

LINCOLN CHARLOT, an eighteen-year-old schoolboy of St. Paul, Minn., showed the other day what can be accomplished by ingenuity and cast-off kitchen utensils. He built himself an ultra-violet or sun-tan-producing "health" ray lamp, using an old bread pan as the casing.

Two rods fixed lengthwise in the pan, parallel and a few inches apart, served as supports for the carbons. The whole apparatus was mounted on a swivel base so its rays could be cast in any direction.

ANCHORED PLANE AIDS FLYER

PUPILS at an English aviation school have all the thrills of real flight without leaving the ground. They get their final training before soloing in a device invented by two engineers of Farnham, Surrey. A small plane, complete with controls, propeller, fuselage, and cockpit, is mounted on a pivot so it can move in any direction while fixed to one spot.

Getting into it the student starts its propeller and executes maneuvers on signal from his instructor. The air stream from the propeller acts on elevators, rudder, and ailerons just as it does in a real ship, causing the "dummy" to turn, bank, and nose up or down in a realistic manner.

An anchored plane, mounted on a pivot, turns in any direction so student gets thrill of flight while learning controls.

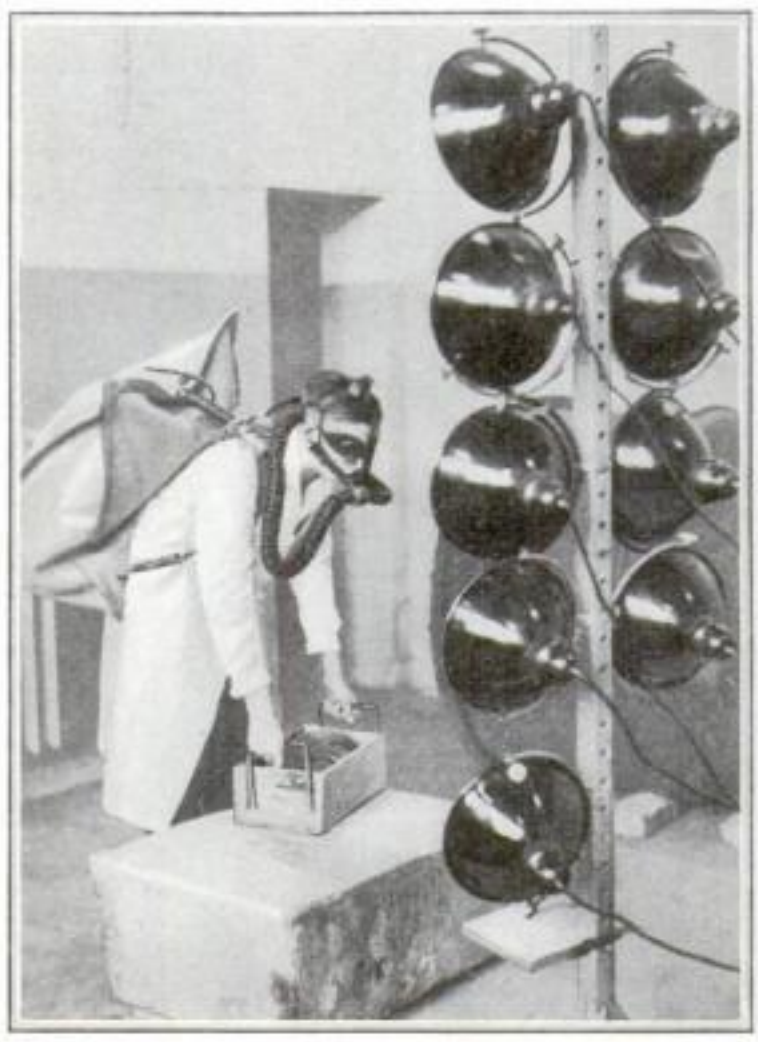
MAN POWER IS CHEAP

IF HUMAN laborers were paid only what their actual physical energy is worth, the average workman would receive a cent an hour. So concluded Prof. William Boss, of the University of Minnesota, after testing typical men with a device that compares their power directly with that of engines, windmills, and water wheels. Subjects were asked to turn a crank which rotated a wheel against a brake, while a scale weighed their effort in pounds.

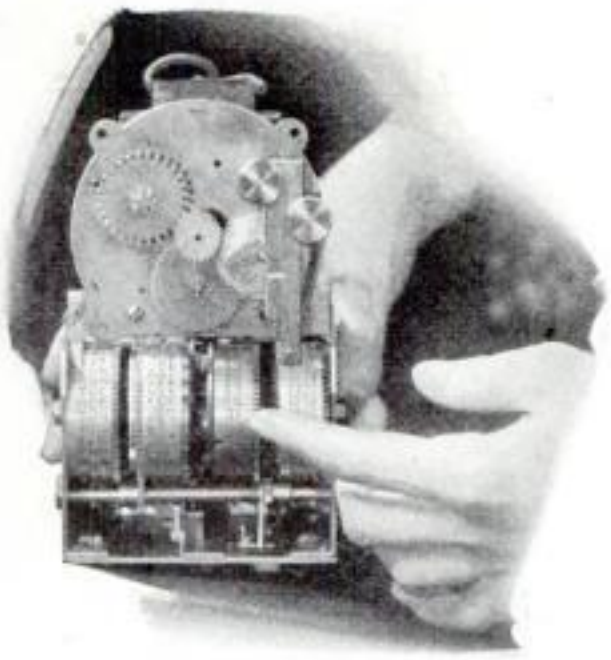
TESTS SHOW HOW HEAT AFFECTS WORK

How much energy does a human being consume doing hard manual work in high temperatures? That is the question scientists are seeking to answer by placing strange looking equipment on the back of a student at the Kaiser Wilhelm Institute, Dortmund, Germany. The subject of the test is made to lift heavy weights in front of a battery of radiant heaters. His breath is collected and stored in a large sack on his back as he exhales, by means of a device that looks something like a gas mask.

When the test is finished the contents of the sack are analyzed, and by the amount of carbon dioxide contained in it, the scientists can tell how much energy has been expended by the worker. A number of other tests were made with the heat turned off, to find the effect of manual work at a normal temperature on the human system. The tests will fix the highest temperature at which miners and others can work without harm.



At the Kaiser Wilhelm Institute, Germany, experiments are being made to find effect of temperature on work.

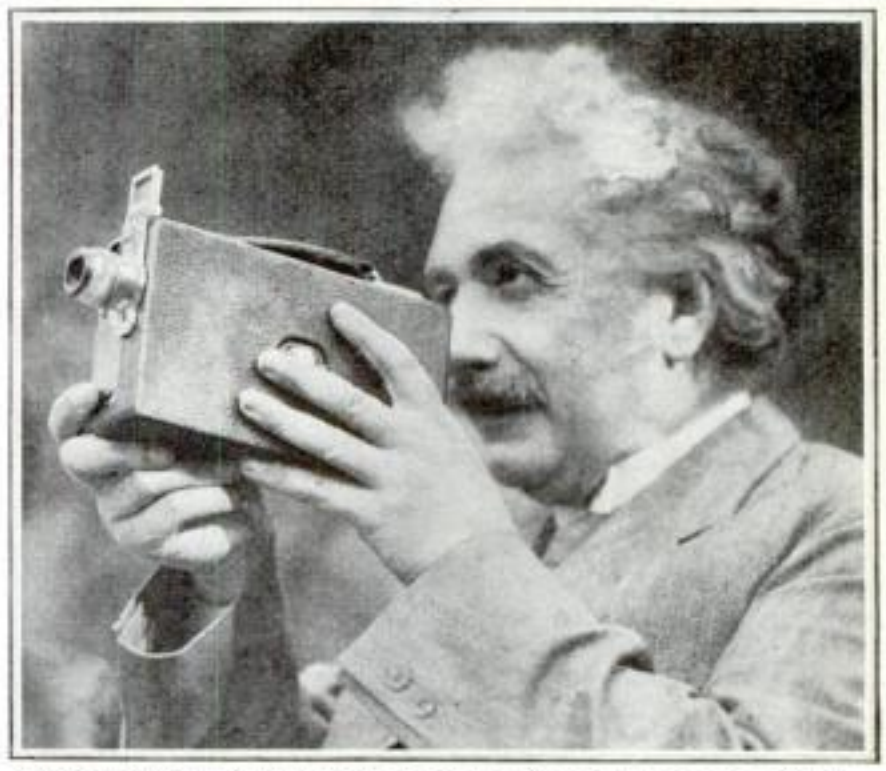


EVERLASTING CALENDAR KEEPS DATES FOR YOU

A MECHANICAL calendar of many uses recently has been placed on the market by a Chicago, Ill., manufacturing firm. Installed in an automobile, it will notify the driver when to change oil and put water in the battery. It also can be arranged to control industrial machinery, electric signs and so on. Gears, electrically driven, operate four rotating drums on which are marked days of the week, months, dates, and years.

HOME MOVIE IS EINSTEIN'S NEW HOBBY

ONE of the latest recruits to the ranks of the army of more than 150,000 amateur movie makers in this country is Albert Einstein, father of the theory of relativity. During his recent stay in California, not far from the hub of the moving picture world, the illustrious German scientist doubtless came under the movie influence of that section. One of the last pictures made of him before he left this country on his return to Europe showed him operating a home movie camera. Thus Dr. Einstein is adding photography to his other accomplishments, which include playing the piano and violin. Also he keeps in his Berlin workroom a powerful telescope with which he makes astronomical observations, a branch of science greatly affected by his relativity theories.



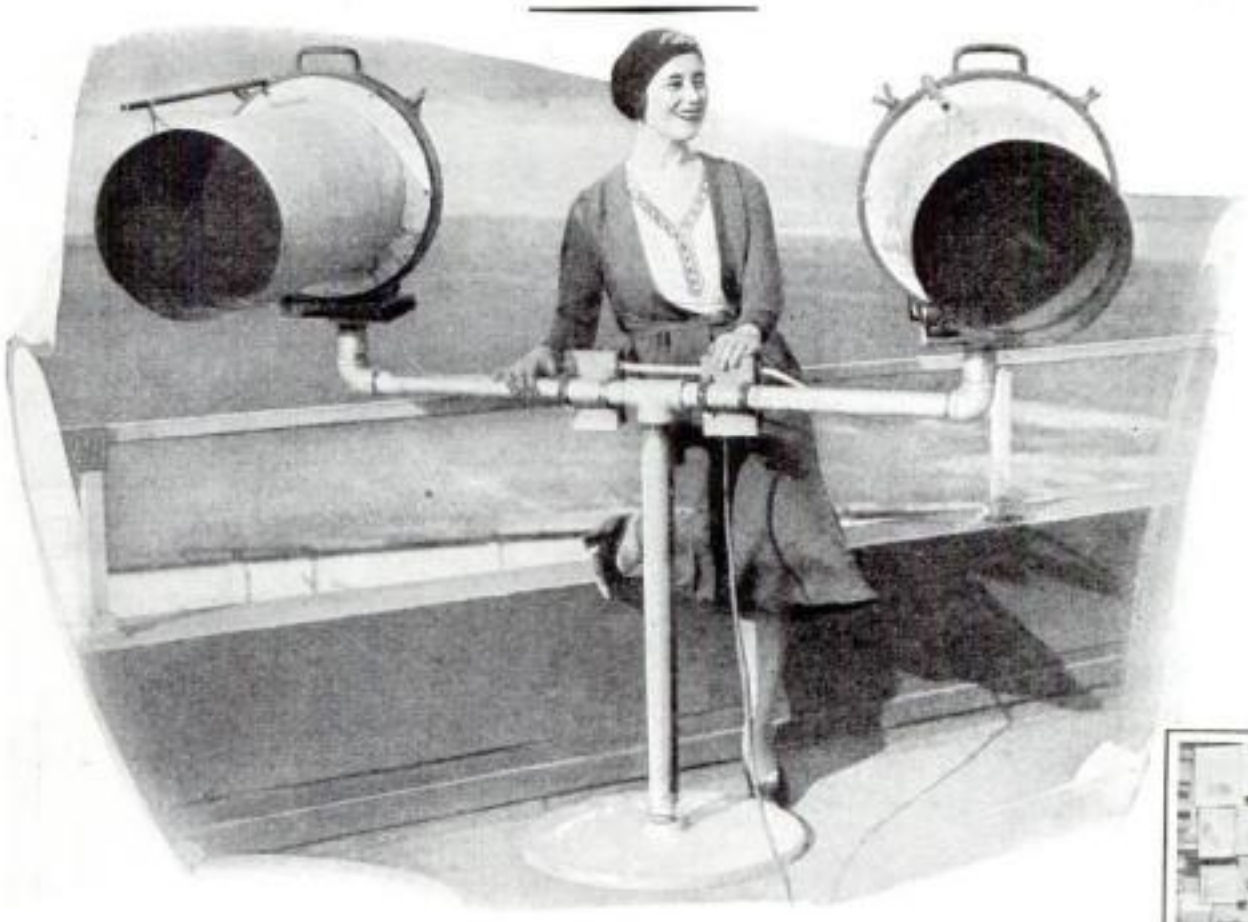
This is the last picture made of Albert Einstein before he sailed for Europe recently and shows him making a home movie.

SKI JUMPER HITS SPEED OF 81 MILES AN HOUR

CHIOGNA, a Swiss ski jumper, recently claimed the title of the "fastest human" as the result of trials with electrical timing devices on a skiing course in Switzerland. The timers showed he attained a speed of 81.82 miles an hour at one point in his arrowlike descent. This is said to be the highest recorded speed ever attained by a human being unaided by mechanical means of propulsion.

ELECTRIC IRON USED TO BRAND TIMBER

LUMBERMEN on the Pacific coast are using an electric branding iron recently perfected by the General Electric Company. A forked handle carries a holder at one end in which a removable brand is inserted. It takes about fifteen seconds to mark a timber with a brand that can be removed only with a saw or chisel.



BIG LIGHTS GUIDE AIRPORT TRAFFIC

GREEN and red flashlights now control movements of planes at the Washington-Hoover Airport, Washington, D. C., Thousand-watt lights are contained in two round sheet iron barrels, each of which can be capped with a red or green lens. The barrels are fitted to each end of an iron crossbar attached to a revolving stand on top of the airport. Also each light is movable individually, so that signals may be flashed to two planes simultaneously. The green light means "Take off," and the red light "Wait for a landing plane."

As the pilot must look almost directly into the barrel to catch the signals, there is little chance that he will pick up the wrong light. These signals are much more easily understood than those made with flags. As the apparatus is on top of the highest building at the airport, the visibility of the lights is great, and the dispatcher has a clear view. The signals were designed and constructed by Charles A. Macatee, chief dispatcher, and Jack Rabbitt, field manager, at the Washington-Hoover Airport.

Delay in branding timber caused by the heating and cooling of brand is done away with by this electric iron. At right, a brand.

Nature Sculptures Strange Forms of Man and Beast in Her Eternal Rocks

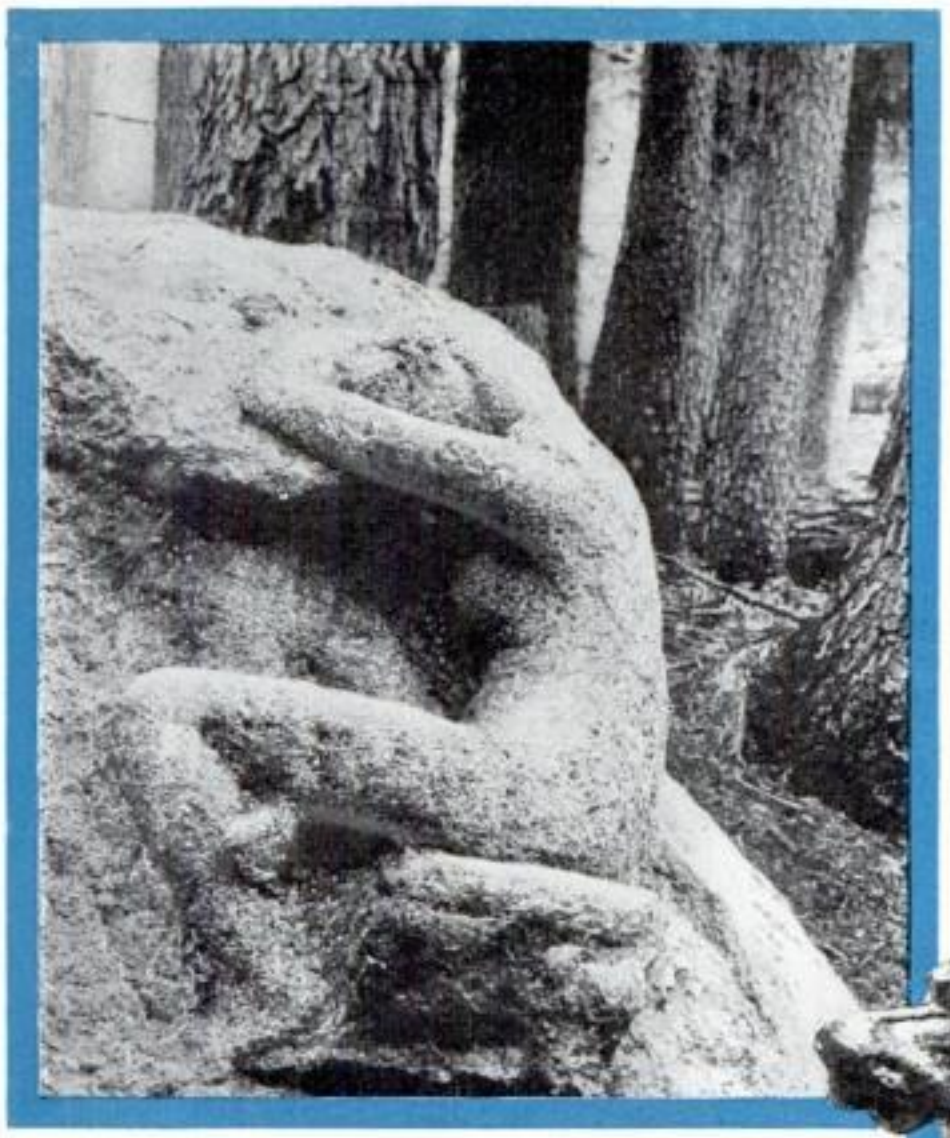
LINCOLN'S PROFILE. Nature carved this face of the Great Emancipator centuries before he was born and left it jutting out into Bear Creek canyon in the Colorado Rockies.

PULPIT ROCK. In Yellowstone National Park stands this bewildering granite freak.

GIGANTIC CHURCH STEEPLES. Wind and water, silently doing their work for centuries, have carried away the easily eroded underlying material and left these mighty church steeples standing near Bozen, South Tyrol, Austria.

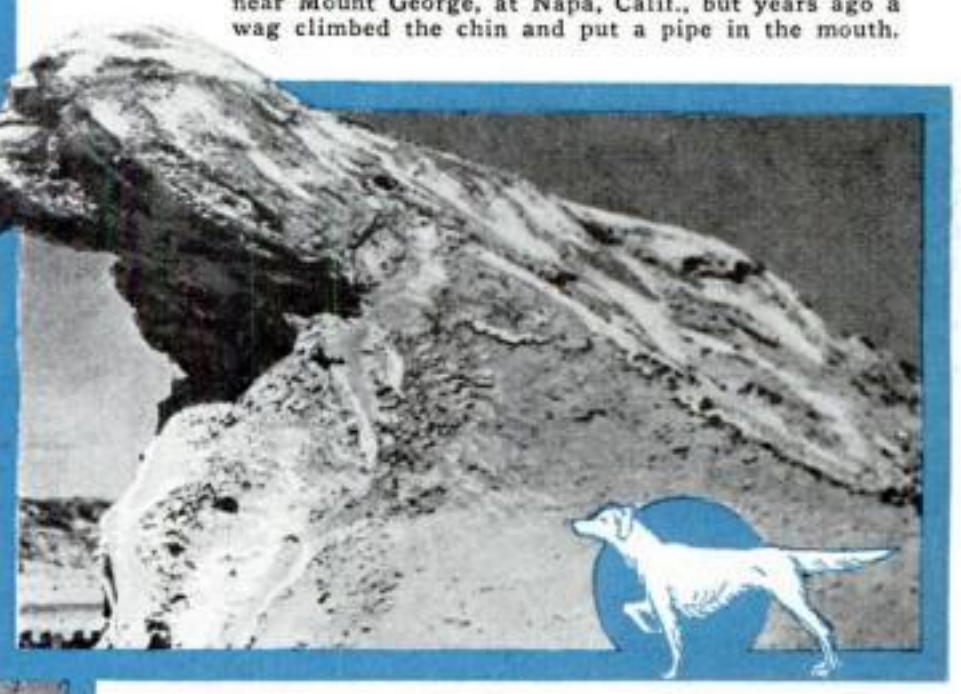
FAMOUS TEAPOT DOME. This rock, shaped like a teapot for a Colossus, is in Wyoming's oil section

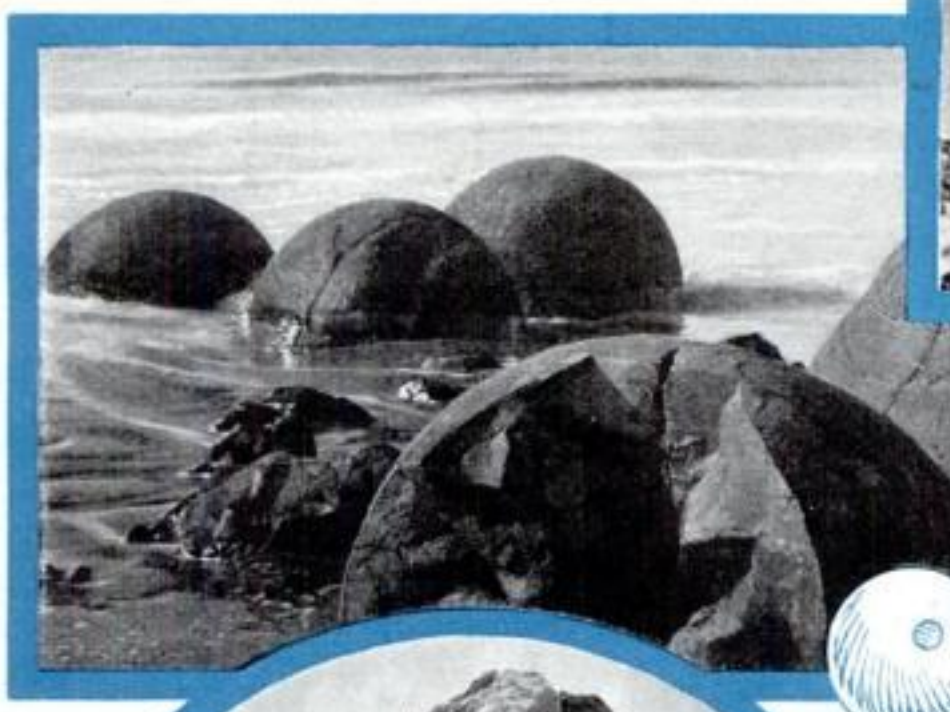
ANIMALS IN STONE. At left, a goose cut out of solid rock by the slow chiseling of wind and rain on the Plateau of Sidobre, France. Above, a forlorn looking and emaciated elephant which stands on the Italian island of Sardinia.



WHO CARVED THIS LADY? This mysterious Woman's Figure was discovered by engineers surveying near Crater Lake, Oregon. Whether carved by man or Nature remains a question.

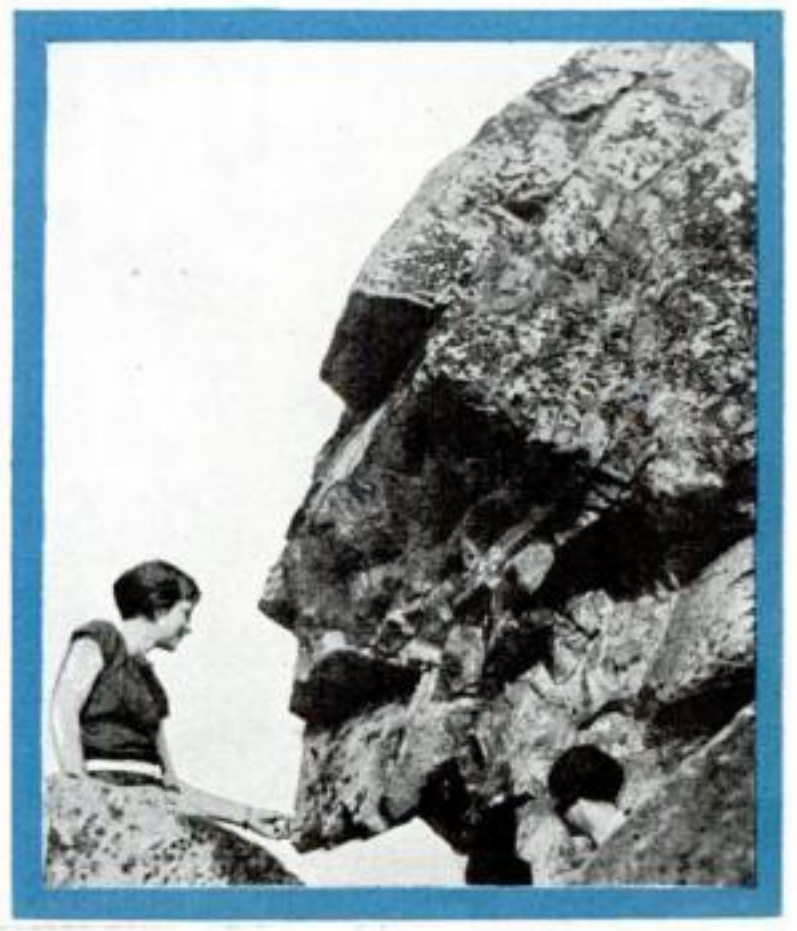
THE SMOKER. Nature carved this fat-cheeked face near Mount George, at Napa, Calif., but years ago a wag climbed the chin and put a pipe in the mouth.





RUSSIA'S WATCHDOG. In the oil district near Baku, Russia, is this dog which strongly suggests a powerful animal swimming strongly out of a mass of stone. Below, the Mountain Man of Assonet, Mass. Sharp featured and old, he has none of the characteristic benevolence that distinguishes his famous rival, The Old Stone Face, in the White Mountains.

AN AGE-OLD MAMMOTH. Frozen in stone, this relic, that may have persisted since the time when the mammoth wandered over the American continent, still stands in the Colorado National Monument. Above, center, are the famous bowling balls, known as Pudding Stones, that rise on the shore near Moerikin Beach, New Zealand.



Entire City Can Hear World's Biggest Loudspeaker

AT TWELVE o'clock noon the chimes of "Big Ben" ring out—not from the English towers of Westminster, where the famous bell swings, but from the Camden, N. J., City Hall. The tone of its English prototype is reproduced without a bell at all, through an electric device that imitates bell sounds.

The top of the City Hall is a veritable loudspeaker tower. Through its 180 dynamic speakers not only the ringing of bells, but speeches and phonograph records are broadcast over the city. They can be heard for a distance of five miles. So great is the vibration of air when the speakers are going that a visitor's clothes flap in time to the music, and entering the tower containing the strongly vibrating air is like walking through mud.

How the men in the tower work the huge battery of loudspeakers is shown in the drawing on this page. Beneath the loudspeakers, which are invisible from the street, is a control room. Here are microphones where a speechmaker may address the city; electric phonographs on which may be played records of Belgian chimes, for amplification through the loudspeaker tower; and the mysterious wooden box containing the electric mechanism for duplicating the sound of Big Ben.

To place the speakers so that all of the sound would not be deflected down into the streets immediately around the tower was a difficult problem in acoustics, requiring months of experiment.

Drawing shows how men work the huge battery of loudspeakers that turn the tower of Camden, N. J., City Hall, right, into the world's loudest speaker.

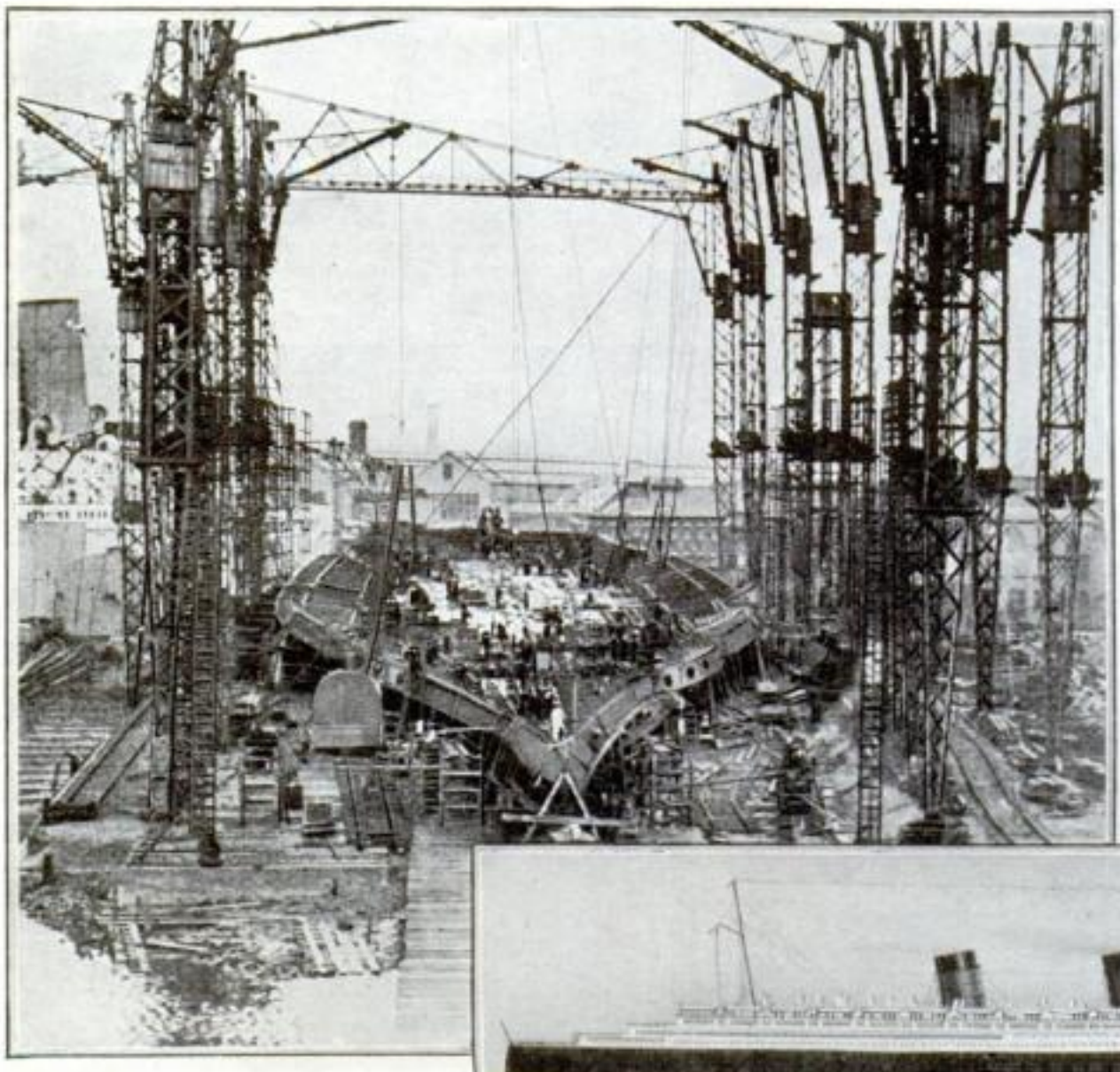
KEEL, 1,018 FEET LONG, LAID FOR FASTEST SHIP

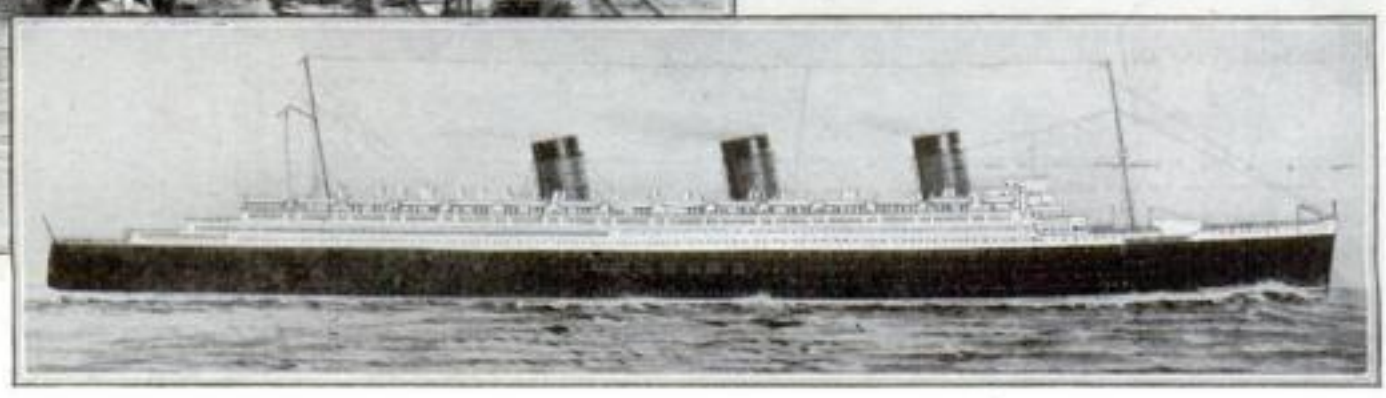
RIVETERS clatter and steel clangs on steel on the shores of the river Clyde at Clydebank, Scotland, where workmen are busy laying the keel of the biggest liner in the world, the new Cunarder that is expected to cross the Atlantic to the United States in four days.

The mammoth ship will displace about 73,000 tons. She will be 1,018 feet long, the first ship in history to exceed 1,000 feet in length. Her breadth will be 115 feet—so large that she would be unable to pass through the Panama Canal, the locks of which are 110 feet wide.

It is expected that this greyhound of the North Atlantic will be handed over to her owners some time about September, 1933. When finished she will have two masts and three sharply raked funnels that will suggest the great speed she is being built to attain.

Preliminary work on new thousand-foot piers in New York harbor, made necessary by the construction of this and other huge new liners, already has been started.





At right, the way the new Cunarder, to be longest and fastest ship in the world, will look when completed. Above, laying the liner's keel.

SKIDDING BUS USED TO TEACH YOUNG DRIVERS

PROSPECTIVE bus drivers are taught how to manage their vehicles in a "skid" on a special skidding ground at a London, England, training school.

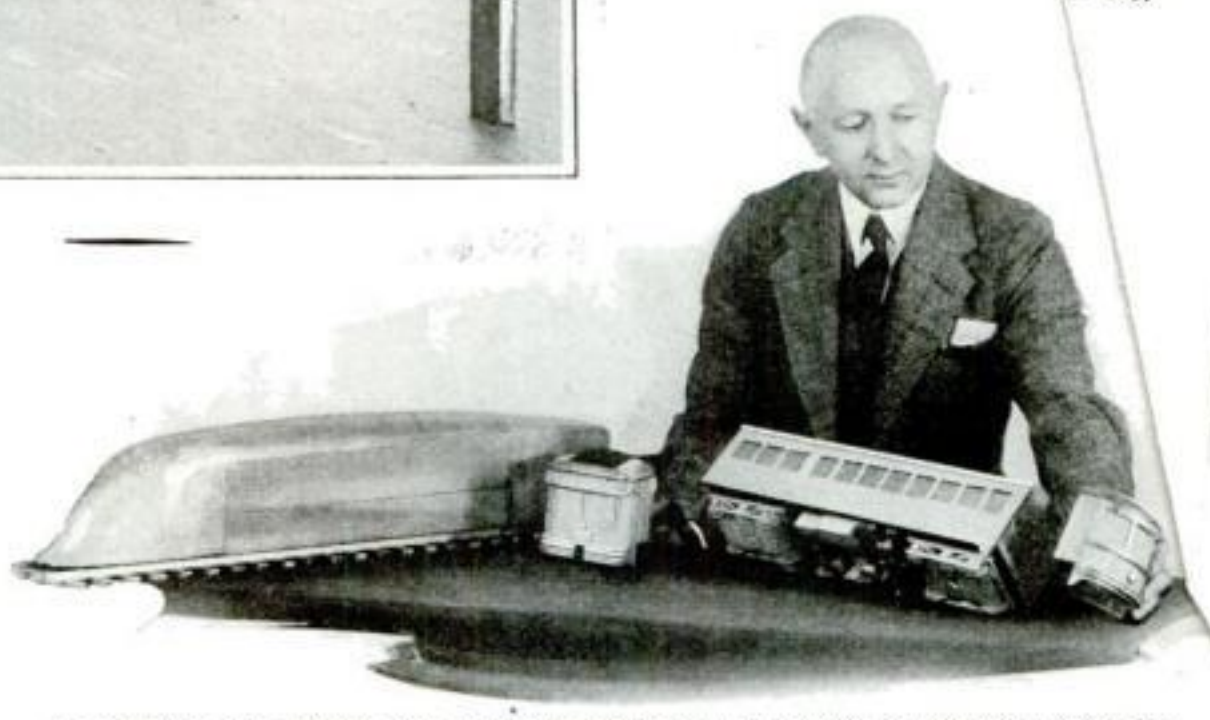
The ground is on a slope, and the surface is regularly dressed with a thick layer of oil and grease over which water is sprayed.

The new driver is not passed as fit to take the bus onto the asphalted streets of London until he is able to apply his brakes without skidding and to drive between a narrow lane of posts placed in a curve. The picture shows an unsuccessful driver knocking down a line of posts by skidding violently around a corner.

STREAMLINE RAILROAD ENGINES FOR SPEED

A WIND tunnel similar to those in which airplane parts are tested is used by Westinghouse engineers at East Pittsburgh, Pa., in experimenting with designs for railway cars and engines. As a result of tests, which showed that engines now in service use too much power in overcoming wind resistance, new types were developed.

Models of locomotives to attain unprecedented speeds present a streamline appearance. Sharp corners are eliminated, projections done away with, protruding and sloped backed fronts resemble racing cars grown to full size. They



Locomotives and railway cars are being modeled in an effort to streamline them for greater speed and lower cost of operation. Models' resistance to air get wind tunnel tests.

20,000 TAXICABS WILL SHOW ELECTRIC ADS

EVEN riders in taxicabs will no longer be immune from advertising signs. A device soon to make its appearance in New York will flash a continuous program of illuminated advertisements before the passenger's eyes.

The new signs will appear in 20,000 cabs in New York and other cities this year. Invented by a New York man, they will flash each of twenty-two signs they contain for a period of seven seconds. They will be mounted above the taximeter where passengers can see them.

NEW JACK LIFTS AUTO BY WHEEL RIM

RAISING autos by their wheel rims is accomplished by a novel jack recently devised by an Illinois inventor. This screw device is operated by a long crank handle, which makes stooping unnecessary.

The jack is placed in position and the car lifted until the tire is clear of the ground. Then the lower part of the tire is kicked clear of the rim, under which a support is placed. With the car's weight resting on this support, jack and tire are removed. When putting on the new tire this process is reversed.

With the car jacked up and the brakes set, two men shaking the car could not push it off the jack, according to the inventor of the apparatus.

This new jack is adapted to raise an auto by the wheel rim, as above. At right, when car is up, supports hold it while tire is changed; then jack is used to lower it.

WIRE AROUND BIG BOLT LOCKS NUT IN PLACE

A WIRE device, developed by an Englewood, Colo., inventor, locks nuts on big bolts. The ring of wire, which fits into threads on the bolt, is made slightly small for them. It is opened up by pressing against two "ears" formed in the wire. After being placed over the bolt these are released and the ring clamps itself around the bolt by the spring in the wire.

SAWDUST FOR FLOORING

SAWDUST mixed with cement was used recently at the Oregon State Agricultural College as flooring material. Floors made of this mixture were, when a little thicker than those of sand and cement, equally strong and much warmer.

JBBER CAP ON CHISEL PROTECTS WORKMEN

A RUBBER cap, molded out of soft ubber, has been patented for use on the heads of steel chisels. It keeps fragments of metal from flying from chisel heads and injuring workmen.

It also prolongs the life of the chisel about three times. With the cap on, the chisel may be used until the head is considerably shattered before it needs regrinding.

In appearance the cap resembles the rubber tip sometimes used on a cane, except the chisel cap has a small opening through which the head of the chisel may be struck with a hammer or sledge. The chip catcher is now being made in various sizes for hammers, mauls, and sledges.

GAS FROM FUSEE PUTS OUT CHIMNEY FIRE

FUSEES, resembling those used for railway signaling, have been perfected for smothering chimney fires. A heavy paper tube about twelve inches long, with a handle at one end, contains the substance which, when heated, releases a smothering gas. When a flue is on fire the fusee is lighted and held in its fireplace, or in a stove connected with it after the drafts have been closed. Extinguishing gas from the tube is drawn up into the flue by its draft and flows for about five minutes.

The fusee is lighted by pulling a cloth tag at one end. This removes a cap, exposing scratching material on the end of the tube. Rubbing the cap against this ignites the fusee, which for a few seconds burns with a red glare. Then the gas escapes, pouring up the chimney.

This new fusee, when ignited, pours out a gas that, flowing up chimney, extinguishes fire.

CONE REFLECTOR FITS ON PHOTO FLASH BULB

A FOLDING reflector for the photographic flashlight bulbs, that take pictures without the aid of powder, is a new accessory for the amateur photographer. It is a cone of aluminum-coated paper and cardboard.

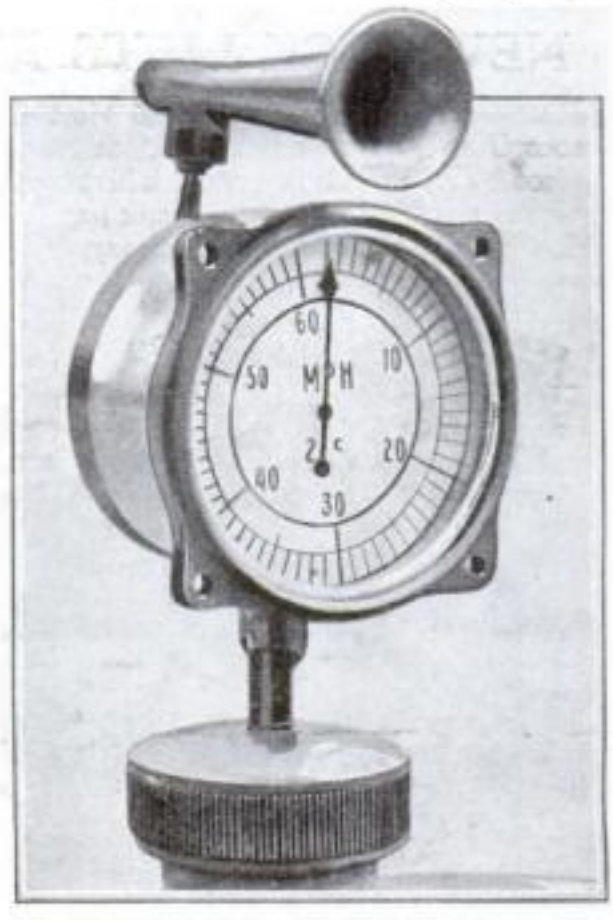
An eight-sided disk of cardboard with a hole in the center is slipped over the bulb first. This acts as a support for the cone, which also slips over the bulb. When both cone and disk are in place on the bulb it is screwed into position in the battery socket.

The new projector works with the "gun" type of dry cell flash lamp or from a lighting circuit.

RIGS RADIATOR CAP AS AIR SPEEDOMETER

BORROWING an idea from aircraft, H. B. Hendrickson, of Washington, D. C., rigged up an air-speed indicator as a radiator cap ornament on his auto.

A venturi nozzle, a somewhat conical-shaped tube, is mounted above the dial of the indicator. Air from the nozzle is forced downward onto a thin plate which is connected with the indicator's pointer.



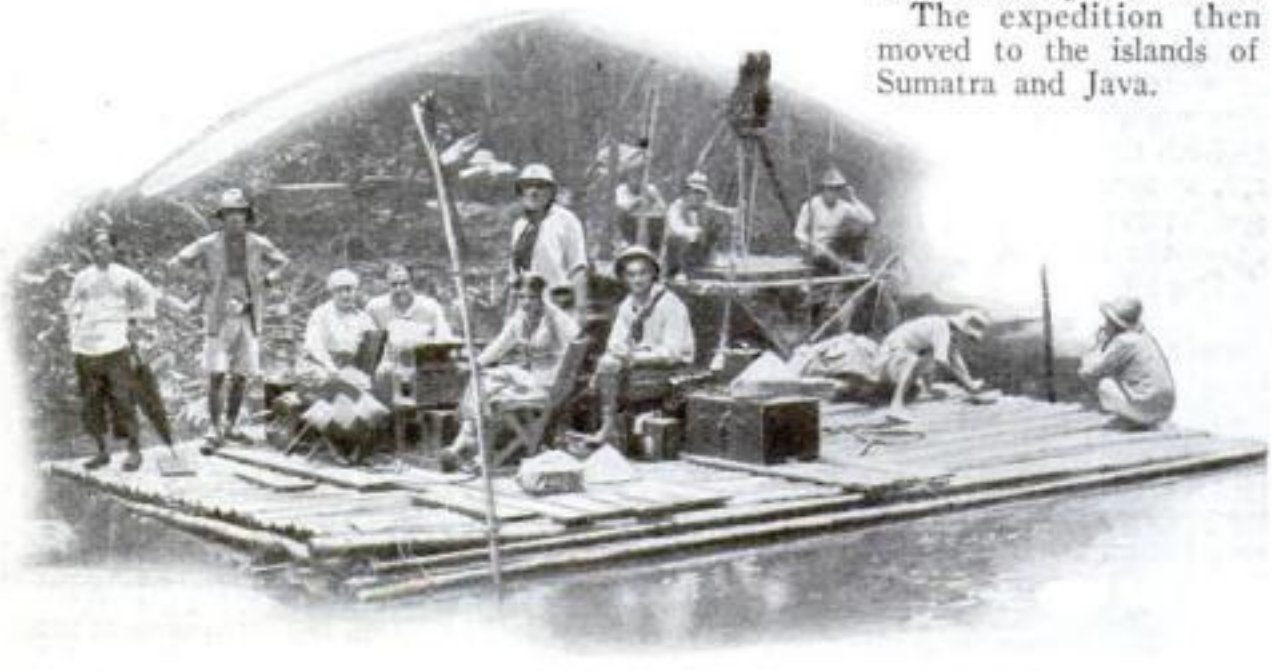
A hornlike affair rigged to radiator cap catches the air and tells its speed past car.

SOUND PICTURE MADE IN REAL JUNGLE

WORKING under almost incredible difficulties, a party of American motion picture people recently succeeded in making a sound picture in the heart of the equatorial jungles of the Dutch East Indies. A base for developing and recording film was established at Singapore in the Federated Malay States. Then the party set out with thirty native carriers with their more than 2,000 pounds of camera and sound equipment.

The first location was 400 miles up the east coast of the Malay Peninsula. Each night the day's take of film was rushed back to Singapore for developing, since they must be developed in this climate within twenty-four hours.

The expedition then moved to the islands of Sumatra and Java.



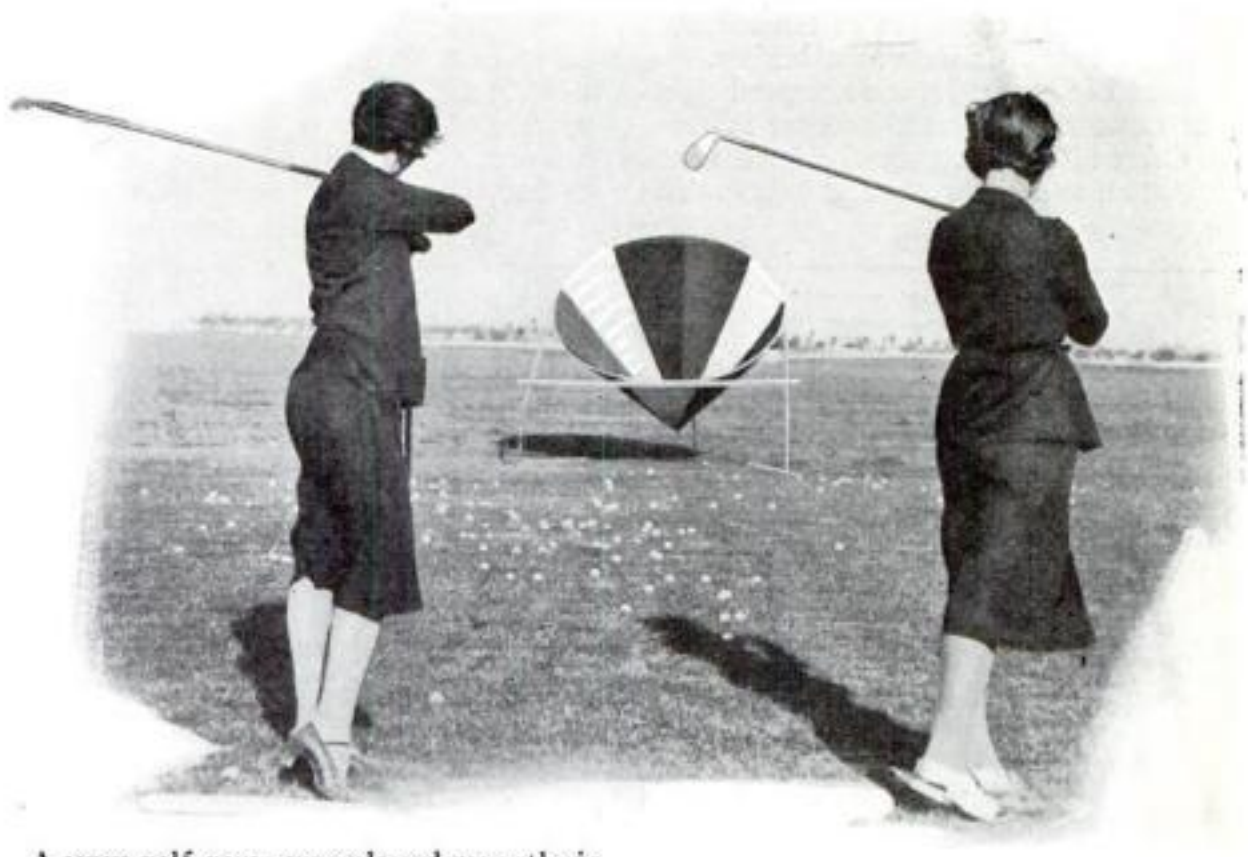
In the heart of an equatorial jungle in Dutch East Indies, a movie company set up its apparatus and made a sound picture. Film had to be rushed 400 miles to be developed after each take.

GLIDER PILOT TAKES HIS OWN PICTURE IN FLIGHT

RAY STAFFORD, California glider pilot, decided the other day to take photographs of himself while flying his craft. He focused a camera on the pilot's seat of his glider and strapped it to one of the wing struts. Its shutter was worked by a string within easy reach of his hand.

He took the picture above when his motorless craft was in a steep bank and turn at an altitude of 600 feet over the dune country near San Francisco. This is believed to be the first time a glider pilot has taken a picture in this manner.

BIG CONES GIVE GOLF NEW FEATURE



Big canvas cones, into which golf players try to pitch balls with short iron shots, are a new feature of the popular outdoor game that recently originated at Los Angeles.

A NEW golf game was played recently in Los Angeles, Calif. Brightly-colored canvas cones, several feet in diameter across their openings, are raised slightly from the ground. They are placed at varying distances from players armed with irons, who attempt to pitch shots into them. Players getting balls into cones nearest them get low scores, but if they succeed in holing out in the farthest ones they get correspondingly higher marks. Each player uses a different colored ball. Obviously the cones are suitable for practice with the short irons only—from the No. 5 to No. 8.

ALLIGATORS LEARN TO SHOOT THE CHUTE

Alligators on this California farm take a deep interest in shooting the chute and quickly climb up to slide down.

THE unusual spectacle of alligators shooting the chute is to be seen at a Los Angeles reptile farm. When a wooden slide was built beside an artificial pond, they took keenly to the new sport. Without difficulty they learned to clamber up a stairway to the top of the slide and coast down it, legs askew, landing with a splash. They entertain visitors to the farm, where 1,000 alligators are exhibited.

USE ALUMINUM ON LUMBER

WINDOW frames, sidings, and other forms of lumber are now on the market coated, not for decoration, with aluminum paint. The paint seals the wood against moisture, so that paint applied later will not crack or peel off. A number of mills have adopted the practice of first drying their lumber, then applying the moisture-proof coat of aluminum.

MARK PACKING CASE WITH FOUNTAIN PEN

The new packing case marker has a barrel like a fountain pen and a felt writing point.

A CONVENIENCE for shipping clerks who have to label packing cases is a fountain pen marker recently developed by Edward S. Garvey, of Clayton, Mo.

Ink is contained in a hollow handle, at one end of which is a felt tip. Through this, the ink escapes to the work in response to a slight pressure on the tip, which opens a small valve in the handle. Reference to the drawing below gives an idea of the instrument's operation.

The flow of ink is governed by pressure, so that the greater the pressure, the greater the amount of ink that escapes. This fact makes it possible to use the pen on rough and absorbent wrapping material.

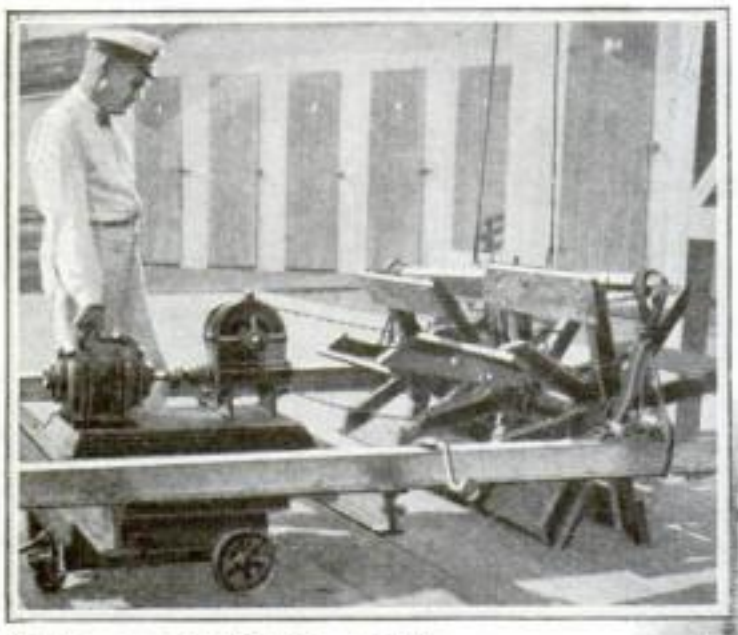
Pressure against the felt point contracts the spring and opens a valve so ink will flow.

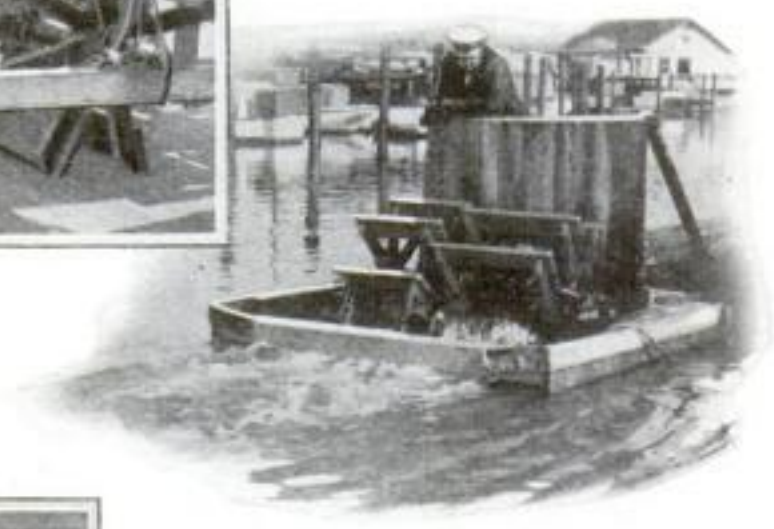
ELECTRIC SWEEPER CLEANS HARBOR

A MOTOR-DRIVEN sweeper similar in principle to those that keep the city streets clean is now in operation at the entrance to an Oakland, Calif., yacht harbor.

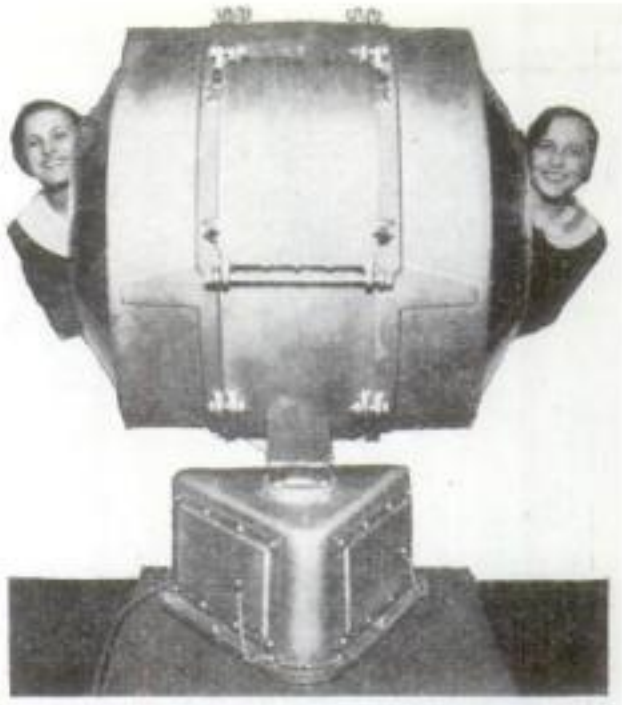
Instead of observing the accepted eight-hour custom, the water sweeper is turning day and night keeping back oil scum, driftwood, and other floating debris. The paddles are six feet long and work to a depth of six inches, causing a surface stream that broadens out fanwise and holds back small floating objects against wind and tide across the fifty-foot harbor mouth. A canvas tarpaulin is stretched between the paddle wheel and the motor to keep the spray from flying over the engine and interfere with its operation.

In addition to the satisfaction of having a clean harbor for the sake of appearance only, yacht owners have now found a way to save the expenditure of large sums that would otherwise be paid out for docking, cleaning, and painting boats which have white or light colored hulls.





Above, a motor-driven paddle wheel sweeper for a yacht harbor at Oakland, Calif., is being assembled. At right, it is seen in action keeping the harbor clean.



NEW AIR BEACONS CAST TWO BEAMS AT ONCE

FOR lighting the paths of night-flying pilots, powerful new experimental air beacons are being installed at different points in the United States. They are unique in that they can throw a beam of light across the skies in two directions at the same time. Special lenses were developed so that the 1,000-watt lamp, with which each beacon is fitted, will cast a 1,500,000-candlepower beam two ways without excessive use of electric current. On clear nights they can be seen for fifty miles. They make one rotation six times a minute.

TEAR GAS OUSTS COPS IN TWO MINUTES

TRYING out latest methods of gassing criminals barricaded in buildings, Boston, Mass., police officers tested the effects of tear gas on fellow members of the force the other day.

Three policemen were stationed in a building at the police training school while tear gas shells from a new type gun were fired into it. So powerful were the biting fumes from the shells that officers could not stay in the building for more than about two minutes.

Tear gas is designed to help police capture criminals without injuring them. It causes the eyes to water badly and burn, without doing them any harm, the effects of the gas wearing off after a short while in the open air. The photograph above shows the tear gas gun being loaded with a shell.

RIDES TO WORK IN SAILING COAL CAR

STRANGEST of commuting methods is that used by W. H. Slater, a dock employee of Kent, England. Each morning when he starts to work he hoists sails on his conveyance, casts off its moorings, and sails away—down railway tracks to his job five miles off over the tracks of an old coal mine abandoned some time ago.

On them he mounted the running gear of an old coal car, and this he rigged with sails. Obviously he can only sail to work with the wind behind him or from a favorable quarter, as he cannot tack.

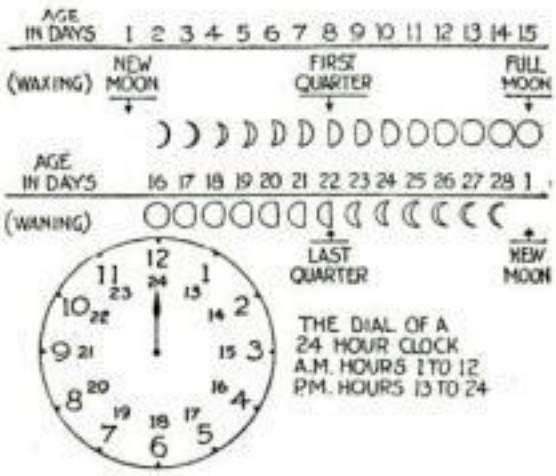
An old coal car on an old coal mine track is fitted with sails to carry this laborer to work.

DIAMONDS HERE WORTH FOUR BILLION DOLLARS

ARE the diamonds in your family jewel chest worth between $150 and $200? If so, they represent the average share possessed by American families. According to a recent estimate, the value of diamonds owned in the United States exceeds four billion dollars.

If all the rough stones mined in 1929, the last year for which mining figures are available, were heaped up in bushel baskets, they would fill two dozen. Combined in a single cube, they would form a block five and a half feet tall and of equal length and width. But only the finest of these become gem diamonds. Others, sometimes drilled with fine holes, are used for industrial purposes, such as drawing fine wire of platinum, gold, and other metals. Much of the wire used for filaments of electric light and radio bulbs is drawn through diamonds such as these.

HOW YOU CAN PREDICT HOUR OF MOONRISE



SUPPOSE that you are planning a day's trip into the country with friends, and this question arises: Will there be moonlight for the return journey, and how much?

If you memorize the rule, you can answer the question on the spot.

Here is the rule, followed by a worked out example.

From the year subtract 1911, multiply the remainder by 11, and from this product deduct as many multiples of 30 as are needed to bring the result below 30. Call this result A. Call the day of the month B. Then take the number appearing under the month as follows, and call it C.

Jan.	Feb.	Mar.	Apr.	May	June
0	2	0	2	2	2
July	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Dec.**
4	6	7	8	9	10

Add A, B, and C together, and if the result is over 30, deduct 30.

If this result is about 8, the moon is at first quarter, or "half-moon" (see diagram). It will be seen overhead at sunset and will set at midnight. If your result it about 15, the moon is full, and will rise at sunset. If your figure is about 22, the moon will not rise until midnight.

But if your result is some other figure than these, you will need the second part of the rule:

Add eight tenths of the moon's age in days to 12, and the result, subtracting 24 if necessary, gives the time of the moon's crossing the meridian. Deduct 6 from this and you will have the time of moonrise.

In the following example the A.M. hours (midnight to noon) are denoted by 13 to 24 instead of 1 to 12.

Required, the time of moonrise on July 4, 1931.

1931−1911=20. 20×11=220. 220−(7×30=210)=10=A.

A+B+C=10+4+4=18. The moon is therefore 18 days old.

Hour when moon is on meridian =12+(0.8×18)=26.4.

Subtract 24 and you have 2.4=2.24 A.M. 2.24 A.M.−6=8.24 P.M.=Time of moonrise on July 4th, 1931. This is within ten minutes of the time given in the almanac.

DEAD GORILLA MADE TO LOOK ALIVE

GOOD material for a heavyweight fighter or wrestler was this gorilla, the skin of which is being mounted at the Smithsonian Institution in Washington, D. C. When roaming the jungles of equatorial Africa in the prime of his strength, this monster stood five feet four inches high, weighed 400 pounds, and had a reach of ninety-seven inches, about twenty inches longer than that of a big man.

Taxidermists are stretching the skin of this brute, which was shot by a Jacksonville, Fla., sportsman, over an artificial model. When completed the whole mounting will present a lifelike apperance.

Gorillas, almost alone among wild animals, cannot live in captivity. Several efforts have been made to preserve them alive for zoological gardens, but the big beasts have always sickened and died after a short imprisonment.

A 400-pound gorilla, shot by a Jacksonville, Fla., hunter, is being mounted at Smithsonian Institution.

LIGHTED MIRRORS SHOW INSIDE OF BARREL

A NOVEL periscope recently developed by a Brooklyn, N. Y., manufacturing firm enables workmen to peer inside paint or oil barrels to see if they are completely empty or clean. In a hollow tube a number of mirrors are mounted, so that when the tube is thrust into the bunghole a view can be had of the barrel's interior. Illumination is afforded by an electric light. Current is obtained by plugging into a handy socket.

NEW WRECKER BAR PULLS OUT NAILS

A WRECKER bar devised by William F. Henderson, of Colfax, Wash., can be used to draw nails. A roller carried in a frame near the claws allows the bar to move. As a result a nail is drawn upward in a straight line instead of in the arc of a circle, and will come out with ease without bending and binding. The handle of the bar is offset so that the operator will not have his fingers pinched if a nail gives way suddenly.

SIX TALK ON SAME PHONE

DUTCH business men may now hold conferences over the phone. A new telephone service put on trial in Holland the other day permits from three to six subscribers to talk with each other over the phone at one time. The new service is finding a wide use in offices.

Mirrors arranged in a hollow tube and electrically lighted reflect view of inside of a barrel when tube is thrust in bunghole.

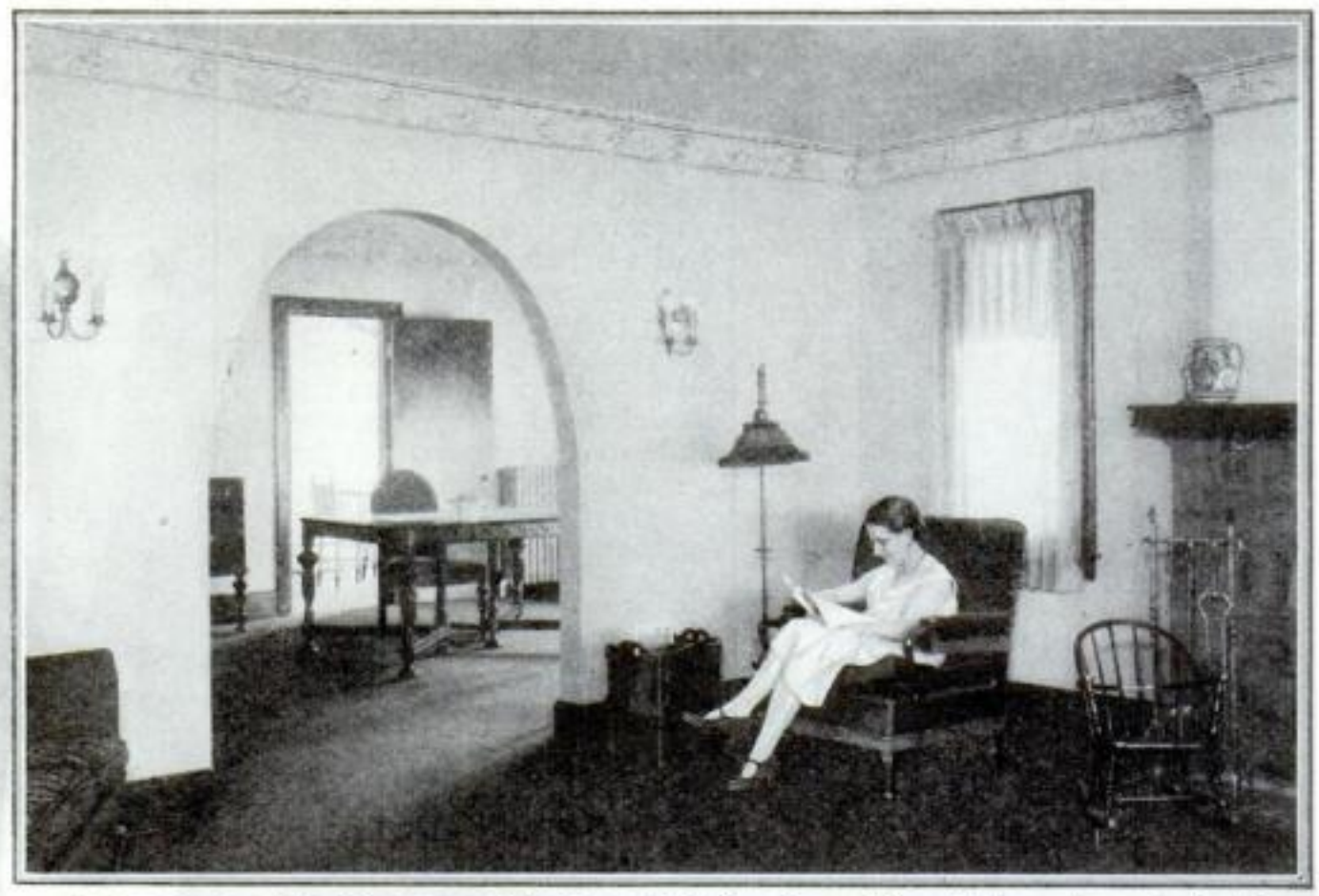
Small Home Builder Builds His Own House—

All His Pet Theories Prove Good

By

JAMES F. CALNON

Recessed stand for telephone with ornamental cabinet for directory.



A cozy corner in the living room of the James F. Calnon home. Through the archway at the left is the dining room. This bungalow, with but one floor, was built for the convenience of the owners.

AS A HARD boiled builder of small houses, I've spent most of my life following the plans of many architects. It has been a pleasure to coöperate with most of them because they know their business as well as I do mine. Of course now and then I have had to argue with some architect whose grand ideas couldn't possibly be interpreted in terms of concrete, wood, plaster, or any other building material.

With such a background, you'd think that the glamour and romance of home building would have become somewhat dusty and shopworn. But it doesn't seem to work out that way. When my wife and I finally decided that it was about time to build a home of our own, we went at it like a couple of newly-weds. We spent a good many nights planning out just how big a house we'd need and just how it should be arranged.

Newly-weds go through the same siege of planning, too, only we had the bulge on the ordinary pair because I know building costs up, down, and sidewise. We didn't have to waste time trying to figure out how much it would cost to include this or that feature. Furthermore, we didn't have to worry about whether we were going to get a good job of building or not. If we didn't, there'd be nobody to blame but myself!

After the general plan was worked out so it suited us, I found that I was itching to try out a number of pet theories I'd developed while building houses for other people. Ideas on heat insulation, heating plant, bathroom fittings, and a host of others sizzled in my brain till I got them all into the plan.

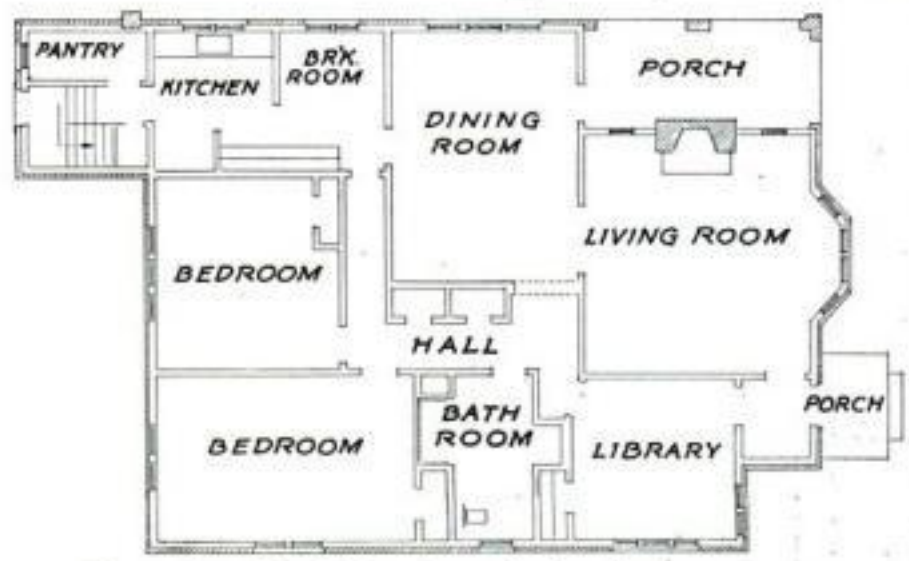
We had a lot in one of the good residential districts of Detroit, Mich., that I had bought some years before. It was of sufficient size to take a house that covered a lot of ground, and as my wife hates stairs and I don't like them much myself, we decided on a bungalow type with all the rooms on the ground floor. The plan on this page shows the arrangement.

IF IT happens to be operating, the first thing that attracts attention from the street is the buried lawn sprinkler system. I have an aversion to playing nursemaid to a garden hose.

The house, as the illustration shows, is of brick veneer. The dimensions are forty by sixty-three feet overall, which is not so large considering the seven rooms all on one floor.

INSIDE the entrance porch there is a small, tile-floored vestibule, where coats may be laid aside.

Going on through the house, the layout, as you will see from the plan, is not only a convenient one, but homey and interesting, with two-way vistas from all rooms in the front part of the house. Where a smaller house is desired, the side porch and library may be left out, retaining the same layout, and giving you a five-room bungalow on an ideal plan. If desired, various features of construction, and many of the refinements described further along, may be of less costly character or eliminated entirely, thus reducing the cost of the house.



Floor plan of the Calnon home showing the arrangement of seven rooms. To save cost two could be cut out.

Passing to the living room, a brick fireplace provides a center of interest on the far side. The wall decoration is in fine color glazing of delicate tones, over canvas. This is true of all the other rooms except kitchen and bath. Canvasing, of course, adds to the cost of decoration, but it insures a perfect job, as there is no possibility of "hot spots" in the plaster showing through, or over-porous places causing imperfect results in the glazing.

Canvasing also prevents the unsightly cracks which so generally develop when the decorating is done directly on plaster

walls. Canvas texture is also suitable for glaze treatments. The trim of the living room, and throughout all the rooms except kitchen, breakfast room, and bath, is in walnut stained finish over birch. Floors are oak throughout, with the exception of vestibule, bath, and kitchen.

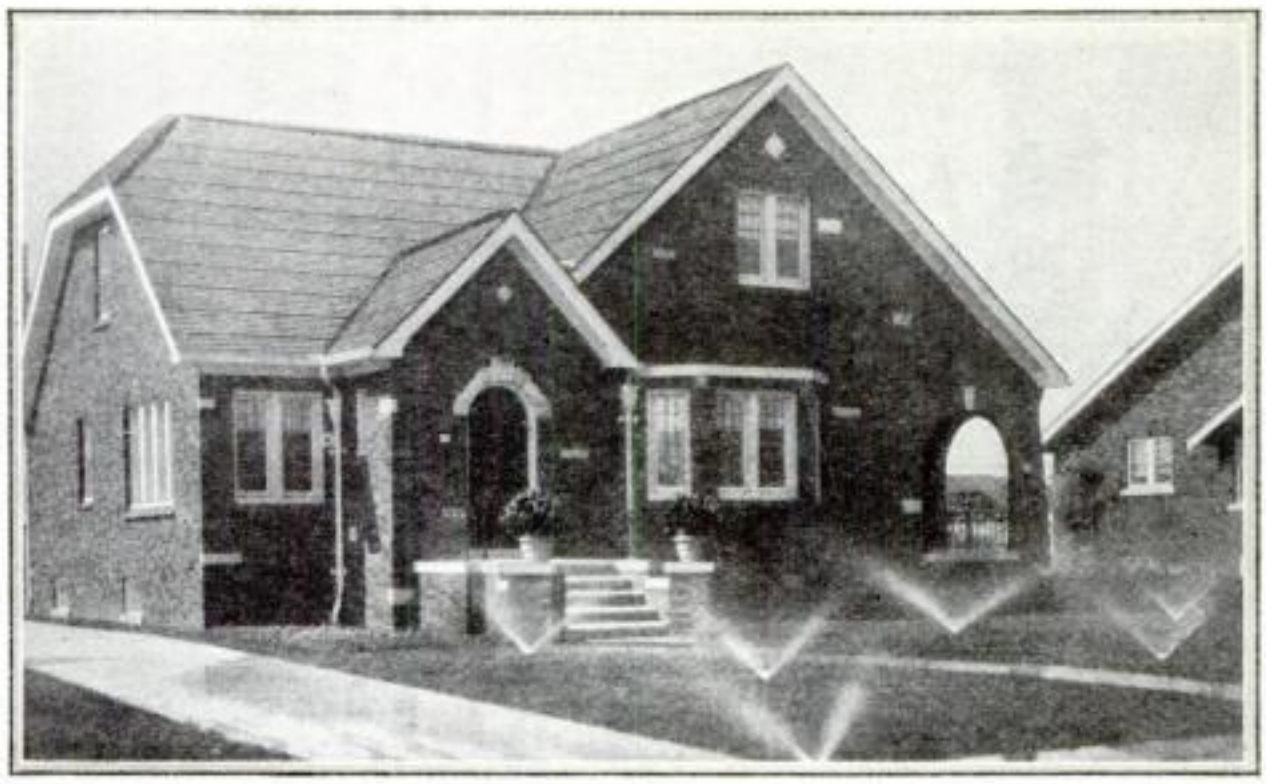
LOOKING through the arch from the living room into the dining room, the effect is pleasing, as shown in the illustration. The dimensions of the room are about fourteen by eighteen feet, a size in which the furniture can be arranged without crowding. Note that there are two radiators in the room, and also that they are not in front of the windows. This method has been followed in all of the rooms.

In my experience, you will get the proper amount of heat better distributed, and at a more economical cost, with two radiators having fewer coils than with one large radiator. Keeping the radiators away from the windows prevents smudging the curtains. From the dining room, a door leads out to a railed-in porch of ample size, where privacy may be enjoyed.

The kitchen has the usual equipment, plus some special features. There is a built-in dome for the electric stove, double drainboard sink, and ample cupboard space. A blower has been installed for ventilation. This particular type of blower provides suction both ways. That is, it can be run to take the fumes out, then reversed, by simply pulling the cord, to bring in a supply of fresh air. It costs only a little more than the single action kind.

THE walls in the kitchen are tiled seven feet high, yellow trimmed with black; woodwork is an off-white shade of enamel toning in with the walls. The floor is embossed linoleum representing red tile. A built-in cabinet of neat design, with leaded glass doors, tones up the whole effect, as does also the well proportioned arch between kitchen and breakfast room, from which a lantern-type fixture hangs.

Just off the kitchen is the refrigerating room, where a modern refrigeration system has been installed. This is another place where I investigated carefully. Considerable improvement in iceless refrigeration has been made during the past year, and we have a system with some new features, the cost of which was reasonable.



Calnon's underground sprinkler system is here seen at work. Controls in the basement make it possible to turn the water on or off without going outside. Pipes are laid to drain easily.

AN IMPROVED type of automatic control valve, for instance, means less starting and stopping of the motor, a feature that will greatly reduce trouble and save wear. This is also an extremely quiet outfit, much improvement having been made in this respect in the recently designed models of all manufacturers.

Connecting the kitchen and breakfast room with the library in the front part of the house is a service hall running past the bedroom and bath. In this hallway is the telephone, fitted into the wall, entirely out of the way. The phone box is concealed, and an ornamental cabinet is provided for the directory underneath the telephone stand. A lantern hangs from the arch above the phone.

In the bedrooms there are no unusual features except, perhaps, the cedar clothes closets—now being used in many homes. Side walls and ceilings, fully surfaced with closely matched cedar, instead of plastered walls, afford the most efficient moth-proof properties.

The windows of the bedrooms, as well as kitchen, breakfast room, and bath, are of the Pullman balance type, so nicely balanced that they may be operated with one finger. This is an especially desirable feature in the bedrooms, permitting the windows to be put down quickly without noisy disturbance when a storm comes up suddenly in the night.

Calnon's kitchen has walls tiled seven feet high as shown in picture at the left. The woodwork is enamel and the floor is linoleum.

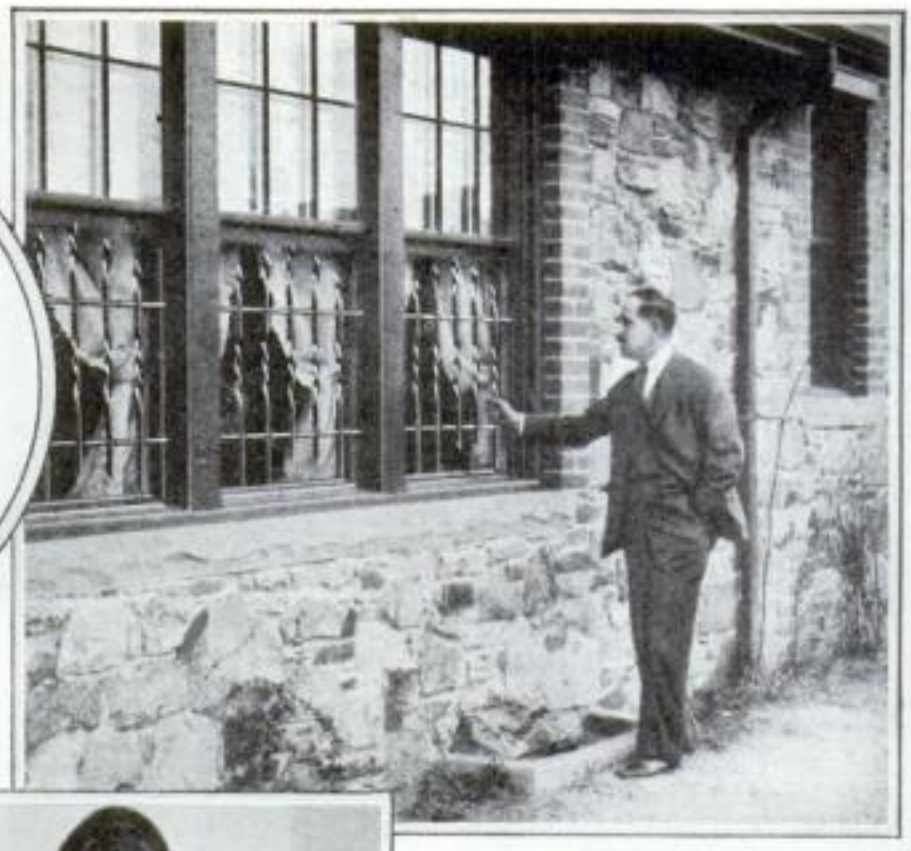
Here is the end of the clothes chute as it appears in the basement. Note the cabinet for holding the laundry materials and the slats that give ventilation, which keeps the clothes from mildewing.

IN SELECTING this comparatively new type of window which operates without weights, I felt that this was one of the places where a little extra cost was well worth while. The windows in the front part of the house are of the casement type, in which antique leaded glass has been used. This, I might explain, is another feature to which we gave particular attention, as casement sash often warps and leaks. In the kind we selected, each window is in an individual frame of its own, and is locked both top and bottom, effectually overcoming this objection.

All windows and doors throughout are fitted with metal weather strips. No one building his own home, in my opinion, should try to get along without this feature, which not only keeps out the wind and weather, making the house warmer in winter and saving fuel, but also keeps the windows and doors from sticking when wood sash and frames swell from damp weather.

The bathroom is large, in keeping with the growing modern trend. The floor space is approximately six by twelve feet, exclusive of the recessed tub. The floor, of course, is tiled. The wainscoting is of the new nonglazed tile, which produces a most artistic effect, *(Continued on page 142)*

Helpful New Tools for Homemakers

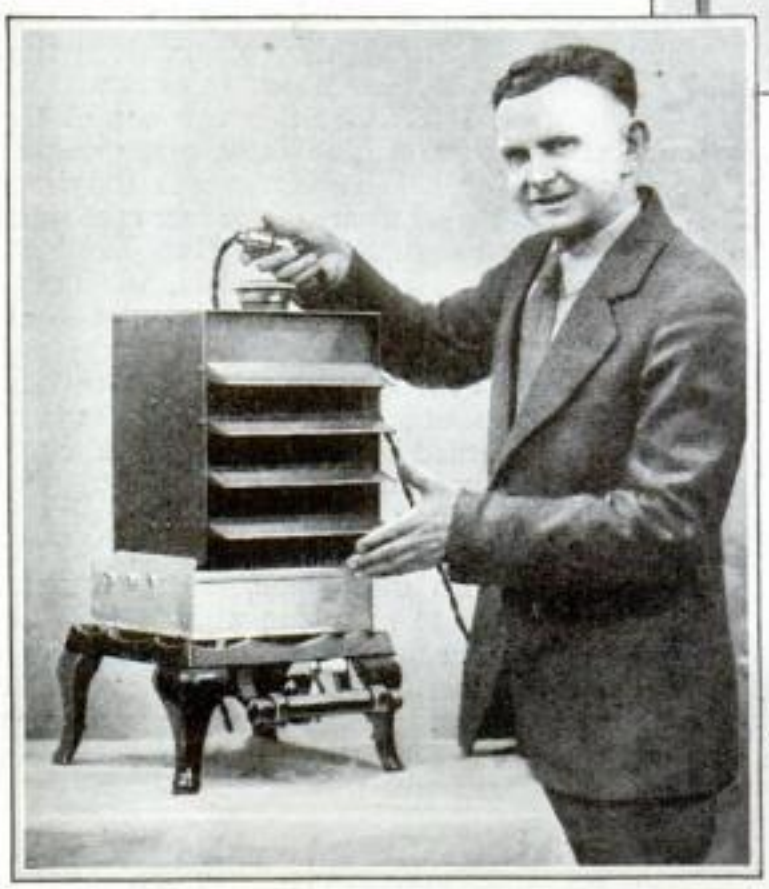


NO BURGLARS NEED APPLY. Sneak thieves trying to get into his Memphis, Tenn., home induced Christie E. Collins, above, to develop this steel guard which consists of five vertical strips and two crossbars and can be locked into any window frame. It efficaciously keeps prowlers out and children in.

COVER SHOWS HEAT. Built into this cover is a thermometer by which the temperature of the skillet, bake pot, or Dutch oven can be observed and regulated to any degree.

VERSATILE GAME TABLE. This folding table can be used for many different purposes, but it is primarily designed to serve as a card and backgammon table. If it is desired to play the latter game, a suitable top turns it into a backgammon layout. Four screws secure top.

VAPOR IN THE AIR. This vaporizer fits over any electric light bulb, the heat of which quickly sends the vapor into the air of the room from any liquid that may be placed in the cup.



HOT WATER ON DEMAND. Louis Emans, of Willmar, Minn., exhibits his recently invented portable hot water heater. It consists of a tank in the base, flues for the heat, a hot water reserve tank, a radiator core, and an electric motor and fan to circulate the air. It is so designed that gas, electricity, gasoline or other fuel can be used to provide the heat.

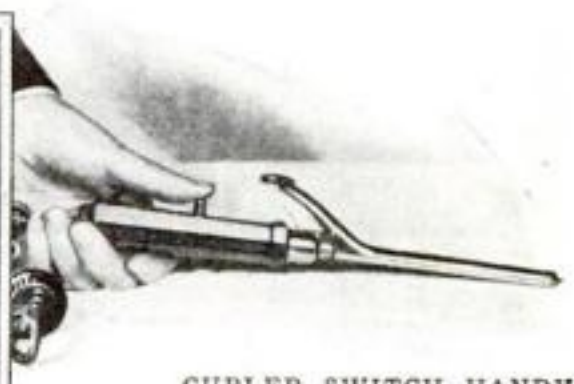
THREE THINGS BUILT INTO ONE. This versatile little contrivance is really a lamp with two additional capabilities. At left it is a lamp but if the shade and bracket are removed it becomes a vase for flowers. Lifting the vase shell reveals an inkstand as seen above. The holes in the base are for cigarette ashes, and this tray is removable.

COMPACT REFRIGERATOR. Especially intended for small apartments is this electric refrigerator of radically new design, the interior of which gives most possible space.

THIS IS NOT A RADIO RECEIVER. Whatever you may think this device looks like, it is in reality an electric heater for drying the hair after a shampoo. Its heater and fan will dry your hair in short order.

INDEX ON PHONE. An English firm has produced this telephone index that fits around the mouthpiece of the instrument. Each letter of the alphabet is seen on a curved segment which has room for the names and numbers of friends.

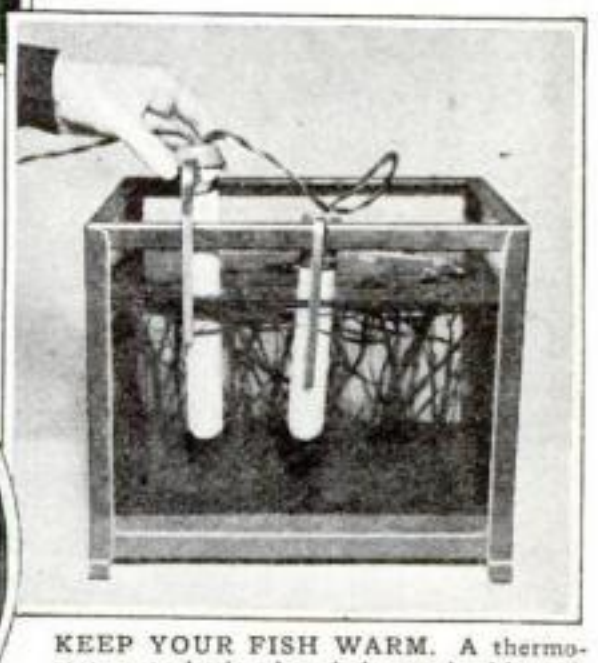
YOU CAN SIT ON THE STOVE. Insulation board with aluminum top cover forms this blanket which keeps heat of wood, coal, or oil stove from escaping, keeping kitchen cool.



CURLER SWITCH HANDY. Switch in curler handle makes it unnecessary to disconnect the plug when dressing your hair.

STOP THAT SLAM. Mounted on a screen door, this wooden screw strikes air cushion piston and stops banging.

MOP AND POLISHER IN ONE. This combination implement is designed to save time and energy, as it is a waxer mop and floor polisher combined. It uses liquid wax.



KEEP YOUR FISH WARM. A thermostat controls the electric heater in this tank so that you can maintain any desired temperature in bowl where tropical fish swim.

STERILIZE THAT CUT. Slight injuries, any one of which may become dangerous, can be thoroughly and quickly treated with iodine pencil, left, which can be refilled.

POPULAR SCIENCE
MONTHLY

RAYMOND J. BROWN, *Editor*
ARTHUR WAKELING, Home Workshop Editor
ALFRED P. LANE, Technical Editor
ISRAEL DOSKOW, Art Editor

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Education and Colleges

A MAN came into our office the other day. He had an idea that he believed would be useful to us. He stated his proposition clearly and with a grasp of detail that was amazing. Nothing had been overlooked. There was no sign of loose-jointed and foggy reasoning.

"Of course," he wound up in an apologetic tone, "I've never been to college and so perhaps I haven't worked this thing out as well as it could be done."

This man revealed a state of mind that is, unfortunately, altogether too prevalent. Many men go through life with the feeling that they can never be quite up to the mark because they did not have a college education. They feel that the college graduate always will have the edge on them. They habitually defer to a college man's opinion.

A man we know who, without the benefit of formal schooling, has worked himself up to a position of responsibility with a great engineering firm, is actually amazed whenever the heads of the business accept his judgment against that of his coworkers who are graduates of technical colleges.

Psychologists call this attitude of mind an inferiority complex. But giving the feeling a fancy name doesn't make it less ridiculous. The idea that a man without a college education must necessarily be inferior to a college man is absurd.

THERE is no magic about a college education. No college can make a bright man out of a numskull. The college may, through mental exercise, stimulate the poorly working brain cells to greater activity just as proper exercises will tone up a deficient muscle. But if a young man, egged on by fear of parental wrath, succeeds in squeaking through college and getting a degree, does his mere possession of a sheepskin guarantee that he is an educated man? Common sense says no.

A college is, after all, only a place where a young man may go to learn things under competent instructors. There are no secrets about what is taught in college. Any of the textbooks used can be purchased through any bookstore.

It is entirely possible to acquire all the knowledge obtainable in college by studying the same books under your own lamp.

We know of one man who did just this in a decidedly novel manner. John Kenlon, now retired, who was for many years chief of the vast New York City fire fighting organization, went to sea as a boy of thirteen and never thereafter attended school. Yet Kenlon is an educated man. Not only in the intricate branches of engineering that he had to know to direct the fire-fighting forces of a great city, but in academic, purely cultural subjects as well. For from the time his son entered high school, Kenlon sat down night after night, with the boy's textbooks until, when young Kenlon finished college, his father had everything he had except a degree.

The purpose of study, whether it is done in the college classroom or at home, is to store your mind with facts. But that does not mean turning yourself into a walking encyclopedia. You want facts not for their own sake but to use in helping you develop your ability to reason from cause to effect or vice versa.

A PROMINENT engineer once told us that it wouldn't worry him a bit if he forgot the details of every mathematical formula and chemical process he had ever learned. Formulas, and facts, he explained, are merely the tools of the trade. The skill of the engineer lies in knowing what to do with them. If a mechanic loses his tool kit he loses nothing but the money value of his tools. He has not lost his skill. A bricklayer is not a bricklayer merely because he owns a trowel.

While it is extremely difficult to say exactly how and to what degree an educated man differs from one who is not, it is simple to tell what type of man will become educated no matter what handicaps he encounters.

If you have an inquiring turn of mind, if you are constantly seeking new facts in order that you may see and understand what lies behind those facts, if you are constantly trying to discover underlying causes, if you are constantly trying to figure out in your own head how the things that are going on now are going to affect the doing of things in the future, nothing short of untimely death can prevent you from becoming, in the end, an educated man.

The type of person who reads and digests the pages of POPULAR SCIENCE MONTHLY is most emphatically in this class.

Blindly accepting a college degree as a guarantee of education also applies the other way around. College men are often prone to look down on the fellow who got his education without sitting behind a classroom desk or listening to professorial lectures.

Sometimes this point of view is carried to ridiculous extremes. A friend of ours, a man past middle age, who never saw the inside of a high school or college as a student, has by dint of his own efforts become one of the best educated men we know. Although successful in business, he has not become absorbed in his work to the exclusion of everything else.

THIS man, whose education makes that of the average college graduate seem trifling by comparison, was talking to his son who is a junior in high school. The father mentioned that he was reading Darwin's *Origin of Species*.

Son, from the prideful height of his sixteen years, came back with: "Why, father, you can't understand that book. You haven't the educational background!"

The quality of a man's education should be appraised on the basis of what he knows and what he can do. Where or how he acquired the education is not of the slightest importance to anybody. If you can go to college, do so, of course, and be grateful for the opportunity. It is undoubtedly the quickest and most efficient way to acquire the beginning of an education. But remember that you have only begun your education when you have finished college, or, through your own unguided efforts, have learned the things that are taught in college.

If you stop learning at that point there is no hope that you will ever become a really educated man. Your brain must receive the stimulation of the constant search after new ideas and new developments. Without it you become mentally stagnant and your knowledge becomes obsolete.

The time to stop studying is when you also stop breathing!

Life's Most Interesting Thing

CURIOSITY is the scourge that drives to knowledge. He who has lost his desire to know is hopeless and of no more use to himself or the world. The thing about which most people are most curious is themselves. Know thyself. The whence, the how, and the whither are urges to a sublime inquisitiveness. Out of nothing—something; and into nothing—what? Turn to page seventeen. There are answers, at least blazings on the trail, that may lead to a more workable knowledge of what you are and why. That, at any rate, is the purpose of this series of articles, the first of which appears in this issue, on life and its mysterious expression in you as a human being. The story, told in an original way by the greatest of living authorities, is, you will find, dramatic, enthralling, enlightening.

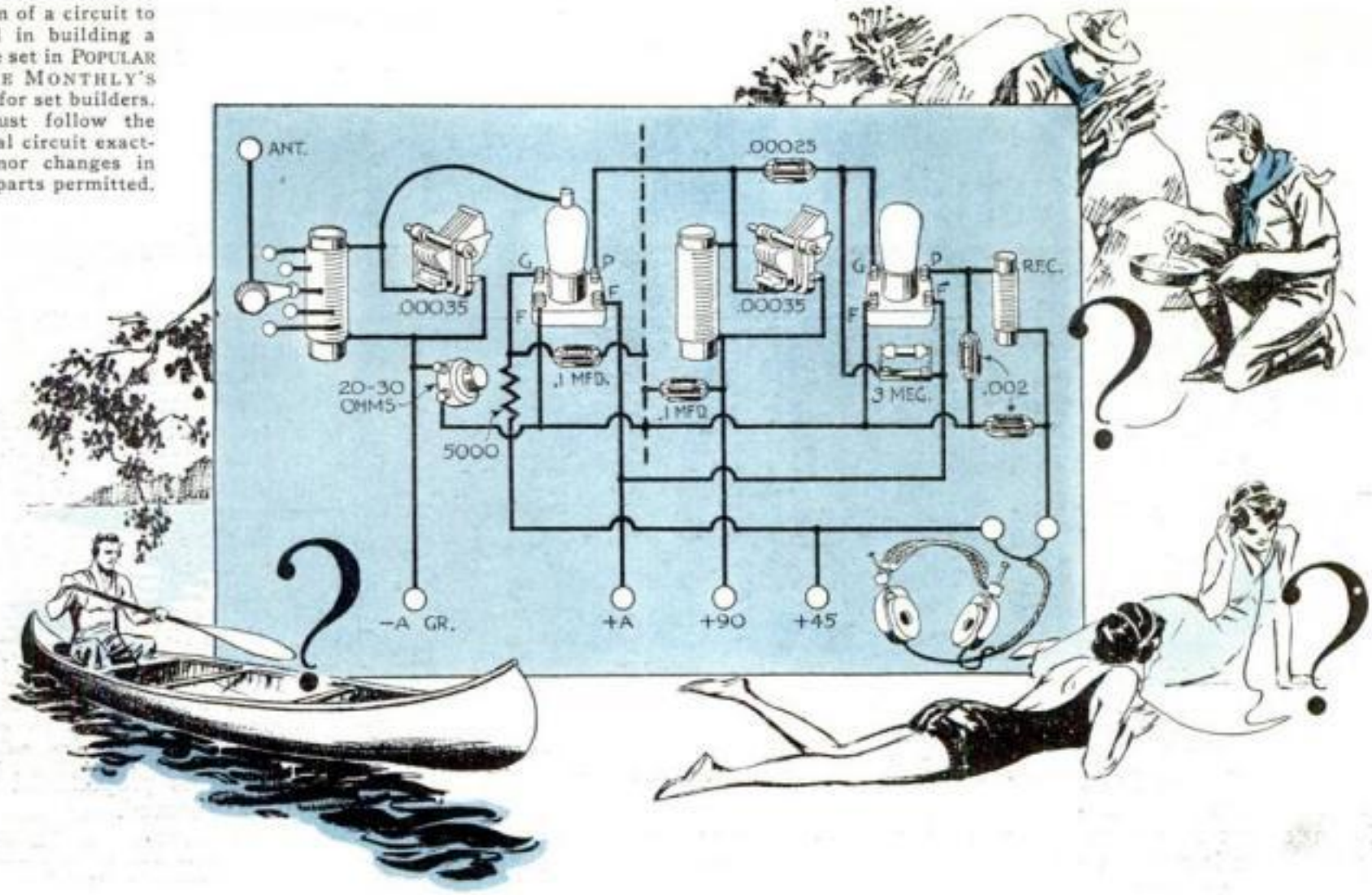


Diagram of a circuit to be used in building a portable set in POPULAR SCIENCE MONTHLY'S contest for set builders. You must follow the electrical circuit exactly. Minor changes in size of parts permitted.

Prize Contest for Set Builders

Best Portable Radio Receivers Built from Diagram on This Page Will Win Cash Awards—Four Rules to Follow

HERE is your chance to build yourself a fine portable radio receiver and win a cash prize for doing it. The contest is open to everybody except, of course, the members of the staff of POPULAR SCIENCE MONTHLY or their families.

On this page is a diagram of an electrical circuit. To enter this contest all you need do is to build for yourself a portable radio receiver utilizing this particular radio circuit. You can use any parts you have or you can buy or make them. You can arrange the apparatus to suit yourself. The portable container can be of any size, shape, or material. It can be purchased or homemade.

There are just four ironclad rules, and they are:

1. You must use the electrical circuit shown on this page.
2. The receiver must use one type 232 tube and one type 230 tube.
3. It must be a complete, self-contained, battery-operated unit.
4. Your entry must be in the mails not later than June 30, 1931.

The first prize will be $50 in cash. The second prize will be $25. The third prize will be $15, and the fourth and fifth prizes $5 each, a total of $100 in cash.

The officials of the POPULAR SCIENCE INSTITUTE will be the judges. They will award the prizes by rating your receiver on a percentage basis figuring twenty-five percent for receiving ability, twenty-five percent for size (the smaller the better), twenty-five percent for weight (the lighter the better), and twenty-five percent for appearance.

Your entry, which must be mailed not later than June 30, must consist of a brief description of the set outlining construction features together with a photograph of the receiver.

The judges will select from these entries a number of receivers to be sent in carefully packed by express collect. The final selection of the prize winners will be made from these receivers. In case of ties each tying contestant will be awarded the prize tied for.

Now that you know the conditions of the contest, the next step is to decide how to go about building your contest set. Naturally, a close study of the diagram is necessary. Note the electrical rating of each part as given on the diagram.

CHECK over the radio parts you have on hand, if you happen to have any, to see which ones meet the requirements. The conditions call for using the electrical circuit specified, but this does not mean that you cannot alter the electrical specifications. You can, for example, use variable tuning condensers of larger or smaller capacity. The same applies to fixed condensers, rheostats, and other parts. The figures given are merely for guidance.

In order to economize on space, you probably will want to wind your own tuning coils. Here are some suggested figures for small coils to cover the broadcast band with a .00035 mfd. variable condenser: One and one half inch coil, No. 28 enameled wire, 85 to 90 turns. One and a quarter inch coil, No. 28 wire, approximately 100 turns; or No. 30 wire, approximately 92 turns. One inch coil, No. 30 wire, approximately 105 turns.

OF COURSE you understand that you may have to increase or decrease the number of turns to give you full broadcast band coverage with the particular condensers you expect to use.

The dotted line in the diagram indicates shielding. If the parts are properly arranged, not much shielding will be required for satisfactory results. A simple metal plate separating the radio-frequency amplifier stage (the 232 tube and the parts associated with it) from the detector stage will prove sufficient in most cases.

Elaborate shielding may increase the efficiency of the set to a slight extent, but it certainly will lose you points because of the added weight. In any event it is not necessary that the set be made absolutely nonregenerative.

As the electrical circuit is specified, your job is to make a set embodying this circuit that will be as light and small as possible. And whether you win a prize or not, you will at least have a fine portable set to show for your trouble!

HELPFUL HINTS FOR RADIO FANS

Hurry Can Ruin Good Radio Job

AMATEUR radio builders and experimenters will soon find that it does not pay to rush things. The more you hurry, the more likely you are to make wrong connections with disastrous results to your tubes or other equipment.

This applies with special force to experimental hook-ups of a temporary nature. When you are trying to find out whether a certain arrangement of apparatus will give good results it is important to make every temporary connection electrically perfect. One poor connection or loose wire is sure to make the operation of the circuit imperfect. In this respect radio work is not like carpentry, for example, where a missing nail or screw may have little or no effect.

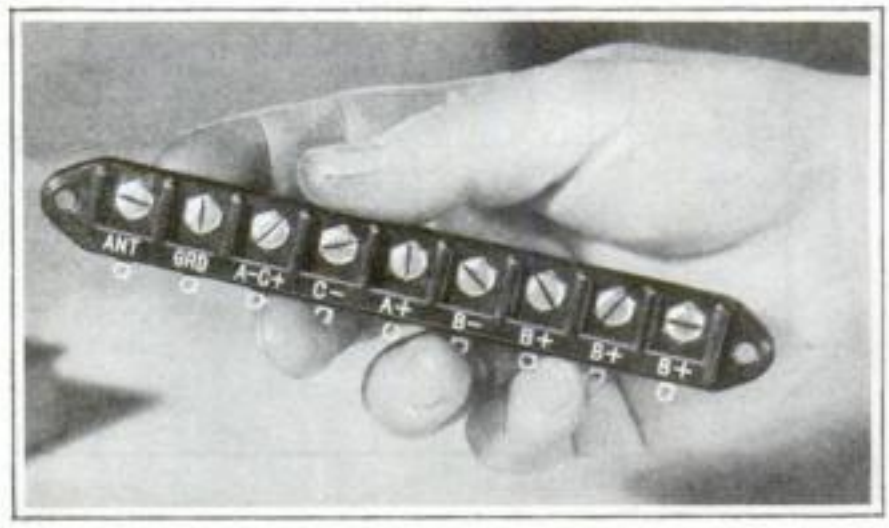


Fig. 1. This new type of terminal strip takes up but little space and assures permanently tight connections to the battery wires.

Many radio experimenters do a good job of wiring a receiving circuit and then nullify the value of their careful work by fitting poor binding posts for the battery connections. In Fig. 1 is shown a new type of binding post or terminal strip that takes up little space and assures permanently tight connections to the battery wires.

THE wires from the circuit are soldered to the lugs which project from underneath the molded composition base strip and the battery leads are clamped under the corresponding screws. Because the terminals on the strip are held in place by riveting, there is slight chance that one will become loose.

Figure 2 shows a novel homemade clamp connector for experimental work. It is made from a safety pin with a wire lead soldered to one leg of the pin near the hinge coil. The ends of the pin are cut off and formed into small loops.

To use, squeeze the pin till the loops coincide, then slip them over the end of the screw to which connection is to be made. When the finger squeeze is removed, the spring of the pin will tend to pull one loop one way and the other loop in the opposite direction. Thus a steady spring pressure will maintain perfect electrical contact in spite of jars or vibrations.

Of course the spring-operated clips, such as are used to make connection to the poles of a storage battery for charging, are more serviceable than these homemade safety pin clips. Furthermore, these spring clip connectors are made in a variety of sizes. But if you haven't the factory built clips, the safety pin units make acceptable substitutes for the time being.

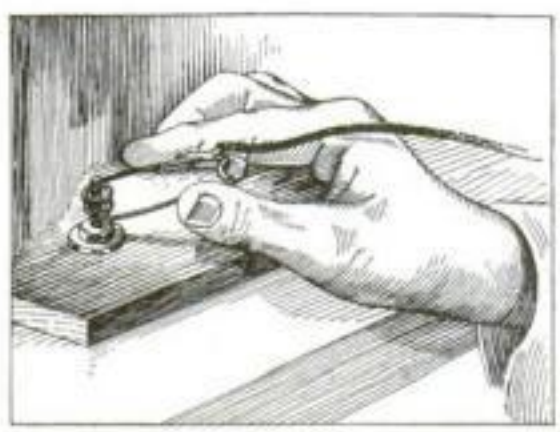


Fig. 2. Here is a novel homemade clamp connector contrived from a safety pin.

Another temporary connection that is often necessary is to a terminal fitted with a small jack designed to take a phone cord tip. Here, too, a regular phone cord tip soldered to the end of the test wire is best, but Fig. 4 shows a way to do without it and still get a tight connection. Whittle a small wooden plug that can be pushed into the hole as shown to wedge the wire tightly against the metal.

There are many other similar ways of doing these jobs and you will be able to work them out for yourself easily enough if you bear in mind that the essential feature is some sort of a spring or wedge action to maintain contact.

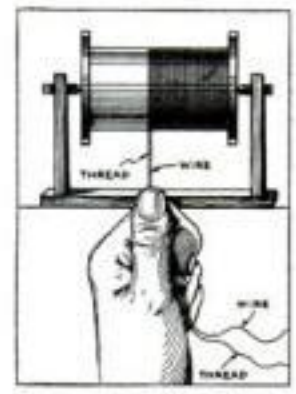


Fig. 3. Winding a thread along with the wire will give you the proper spacing.

A SHORT WAVE SET

MANY amateurs have on hand an old set that has been supplanted for regular broadcast reception by a more modern receiver. The idea often is brought up as to whether these old sets can be converted for short wave reception. The answer unfortunately, but most emphatically, is no for a number of reasons which were given in a previous article (P.S.M., May '31, p. 82).

The best you can do is to salvage some of the parts for use in a short wave circuit of conventional design. Variable condensers, for example, may be reduced in capacity to suit the various short wave plug-in coils. Sockets and rheostats also may be saved and even, in case of necessity, the wire from the coils can be removed and rewound to short wave specifications.

The capacity of a variable condenser can be reduced by increasing the spacing of the plates, or by reducing the area of the plates either by cutting off some of each plate or removing some of the plates. The last is the only practical method for the amateur. It is not necessary to remove both the stationary plates and the corresponding rotary plates. Remove either one type or the other type to get the capacity you want. Reduction in capacity is proportional to the plates removed.

SIMPLE SPACE WINDING

THE specifications for short wave coils often call for space winding, which means that a space is to be left between each turn. Usually the winding is given as so many turns per inch of a certain size wire. If an engine lathe is available, the problem is simple, because the coil form of rubber or composition can be placed in the lathe and a groove cut for the proper number of turns per inch, using a thread cutting tool and the thread cutting mechanism of the lathe.

Fig. 4. A wooden plug can be used to hold wire securely in hole.

However, relatively few radio experimenters have access to an engine lathe, and so some other method must be used. Perhaps the most practical is to wind a thread on the coil form along with the wire, the thread giving the proper spacing (see Fig. 3). A few trials with various sizes of thread, or string for the coarser windings, will show you how to get the proper spacing.

After the coil is wound fasten the ends, carefully remove the thread, and tack the wire to the coil form in several places by means of rubber cement or collodion, being careful to use as little as possible.

Of course a coat of shellac would hold the coil in fine shape, but shellac adds to the electrical resistance of coils to be used at the high frequencies of short wave reception.

In theory the best coil would have bare wire and be supported by air alone. In practice there must be some mechanical means of support, and unless the space winding is exact, insulation is necessary. One short-circuited turn will spoil any coil. The difficulty with insulation is not electrical leakage, but unwanted capacity.

New Screen Grid Tube Ends Distortion

By ALFRED P. LANE

Note control grid spaced at one end in tube above, which gives same effect in tone control as imaginary "stretchable" grid at left.

RADIO engineers are confronted with a whole new set of problems as the result of the enormous amplification possibilities of the modern screen grid tube.

The chief problem has been to find a way to control the volume of the super-powerful multi-stage screen grid receiver without introducing severe tone distortion or the form of interference known as "cross modulation" or the jumbling together of two stations.

Now a remarkable new type of screen grid tube has been developed that provides a perfect solution for this trouble. Like the chameleon which can change its color to match its surroundings, the new tube automatically changes its characteristics as the volume control is turned so that there is no longer any chance for distortion when powerful stations are turned low.

Most radio fans do not realize what a tremendous problem is involved in controlling the volume of the modern, high grade screen grid tube radio receiver. The set itself has an over-all amplification from the antenna to the loudspeaker of, perhaps, a million to one or more. Then the difference in the intensity of the signal picked up by your antenna from a powerful local station as compared with signals from a weak distant station may also be in the neighborhood of a million to one.

In the radio tube, the grid controls the flow of plate current and consequently the amplification of the tube. By changing the voltage applied to the grid, usually called the C bias, the amplification of the tube can be changed but only within certain limits for a high amplification tube such as the screen grid type 224.

WHEN you make too great a change in the voltage all sorts of unpleasant things happen. Part of the incoming radio wave is lost and of the remainder, the peak is amplified out of proportion to the rest of the wave. The result is ragged, disagreeable reproduction of voice or music.

Furthermore, when the tube is suppressing part of the wave it is acting as a rectifier instead of as a true amplifier. When the first tube acts this way, it mixes the waves from incoming stations and no amount of selectivity in the circuit after the first tube can separate them.

In the past, two methods have been used to combat this "cross-modulation" and distortion. One has been to introduce tuned stages ahead of the first tube to separate the stations. This works well but of course adds to the cost and complexity of the receiving circuit. It does not eliminate the distortion caused by operating the tube with the wrong grid voltage.

The other method has been to combine two forms of volume control on one knob. One cuts down the amplification of the tubes and the other reduces the strength of the signal from the antenna before it reaches the first tube. This method involves circuit complications and adds to the cost of construction.

If the receiver were perfectly shielded, a condition never quite reached in practice, an excellent way to control the volume would be to change the length of the antenna. Theoretically, you could construct an antenna that could be reeled in like a fishline to control volume.

ANOTHER way to get good volume control would be to make a tube the internal structure of which could be modified at will to change its amplifying qualities. If, for example, it were possible to make a tube so that you could turn a wheel outside the glass and so compress or extend the small grid coil and thus change the spacing between turns, you would have an ideal form of volume control. But that is a mechanical impossibility.

Other things being equal, the amplifying power of a tube is determined by the spacing of the turns of the control grid. The closer together these turns are placed, the greater the amplifying power and the more severe the distortion when the grid voltage or bias is changed to reduce the amplification. Widening the turns of the control grid coil in the screen grid tube allows much lower volume without distortion but at the same time considerably reduces the maximum amplification obtainable from the tube.

In theory, a fine control could be obtained if two tubes, one of the high amplification type and the other of the low amplification type, were operated in parallel in the first radio-frequency stage of the radio receiver. In such a circuit, if the grid bias voltage were set for the high amplification tube, this tube would do all the work. Then if the voltage were changed, that tube would stop operating and the lower amplification tube would begin to function.

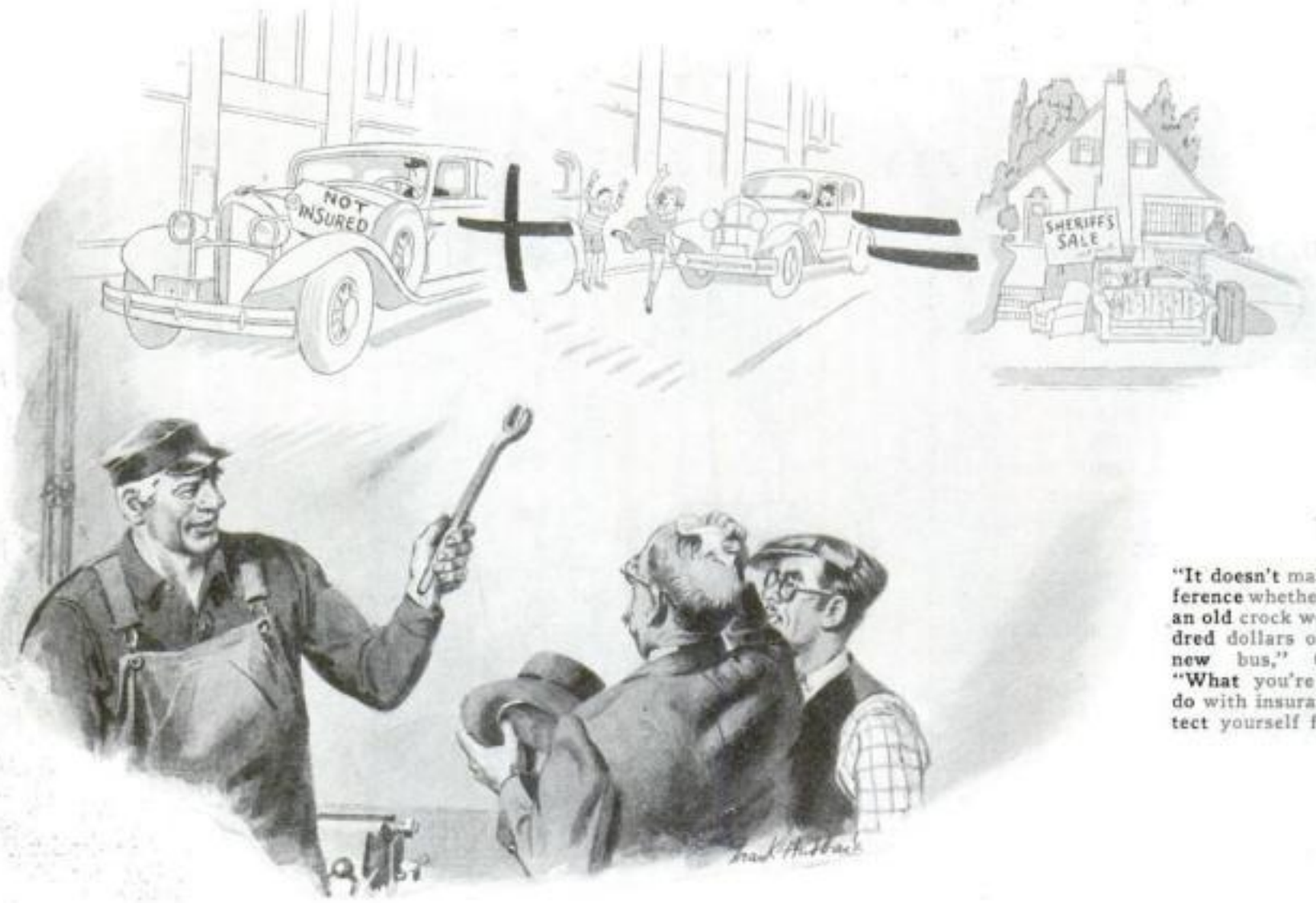
The new screen grid tube works on this theory. It really is two tubes combined in one. As the illustration shows quite clearly, it is made with a control grid spaced more closely at one end than at the other. This gives the effect of two tubes because the upper closely spaced portion of the control grid acts like the ordinary type 224 tube.

The lower section where the turns are farther apart comes into action when the volume control is turned and results in cutting down the amplification as desired without scrambling stations or causing tone distortion.

THIS new automatically variable screen grid tube, which probably will be made by several prominent tube manufacturers, is not strictly interchangeable with the regular type 224. However, in some of the early screen grid receivers that are long on sensitiveness and short on selectivity due to cross-modulation, the new tube would effect an improvement if used in the first stage in place of the usual type 224 tube. In some sets merely substituting a tube of this type will improve results without making any changes in the circuit. In others, results will be even worse than with the type 224. It all depends on the circuit constants of the particular receiver you are trying to improve.

If you are troubled with "cross-talk" and too much interference from the local station, consult your local radio service man, preferably the man from whom you purchased the set. He can tell you if the substitution of the new tube will help.

Why Your Car Needs Insurance



"It doesn't make any difference whether you drive an old crock worth a hundred dollars or a brand-new bus," Gus said. "What you're trying to do with insurance is protect yourself from loss."

Gus Lays Down the Law About Taking Chances and Tells Why Fool Drivers Fail to Protect Themselves and the Public

By MARTIN BUNN

GUS WILSON fingered the crumpled fender while he gazed appraisingly at the other damaged parts on the front end of the car.

"Lemme see," he rumbled, counting on his huge fingers. "First there's the mudguard. That's a total loss—beyond fixing. Then there's the end of that bumper. Maybe I can save that, but the lamp is a wreck. The radiator's sprung a leak. I guess it will cost you about thirty-five dollars, Mr. Cardon."

The motorist, who had driven his damaged car into the Model Garage a few minutes before, whistled.

"Here's where the old bank roll gets another sock," he grumbled. "But I guess you're not sticking me at that. I can see there's a lot of work to be done. For once I'm sorry I didn't have collision insurance so I could let the company hold the sack."

"You'd never have collected a nickel on this accident," Gus asserted as he got out his tool kit and set to work.

"Why wouldn't I?" asked Cardon. "That's what insurance is for, isn't it?"

"You forgot about that fifty-dollar clause all the insurance companies put in their collision policies," Gus explained. "You always have to pay the first fifty dollars yourself. The company only pays costs over that."

"Well, I'll be jiggered!" Cardon exclaimed. "They insure you and then make you pay! I always suspected this auto insurance business was a racket. I've saved a lot of money by not carrying any."

"Do you figure that way about fire insurance on your house, Mr. Cardon?" asked Gus mildly.

"OH, THAT'S different," Cardon replied. "You never can tell when your house is going to burn down, and, if it did, and you didn't have insurance, you'd be wiped out—at least I would. Auto insurance isn't the same thing at all."

"That's just the trouble," Gus growled. "You think about auto insurance as if it didn't apply to anything but your car, and that's where you're dead wrong. Suppose tomorrow you drive down the street and some kid steps out in front of you and you smash him. Suppose you make him a cripple for life.

"THEN comes an expensive court trial and the jury slaps a fifty-thousand-dollar judgment on you. They'd take away your house and your car and everything else you own that the sheriff could lay hands on, right down to the clothes on your back. You could keep your clothes, and that's about all."

"Rats!" Cardon scoffed. "I've never run over anybody yet and I don't intend to start now."

"Maybe so," said Gus. "I guess nobody ever smashes anybody intentionally. But the best drivers have accidents now and then."

"Besides," Cardon argued, "what good would it do if I had a policy for, say, five thousand dollars and I got nicked for fifty thousand? They'd grab everything I owned anyhow."

"That would be like having a two-thousand-dollar fire insurance policy on a twelve-thousand-dollar house. There's nothing to stop you from carrying a bigger liability policy," Gus suggested.

"That would be a good joke," Cardon scoffed. "Carrying a fifty-thousand-dollar policy on this (Continued on page 151)

Gus Says—

THE sun shining on your brand-new car sure makes it look like a million dollars, but that same sunlight is what spoils the finish. It's the ultra-violet in sunlight that does the harm. It weathers the surface, spoils the shine, and makes it look old. One reason why the various wax polishes make the finish last longer is because they keep the ultra-violet light from reaching the lacquer.

BETTER SHOP METHODS • NEW IDEAS FOR THE HANDY MAN • BLUEPRINTS

MODEL MAKING • HOME WORKSHOP CHEMISTRY • THE SHIPSHAPE HOME

How to Take Better Photos

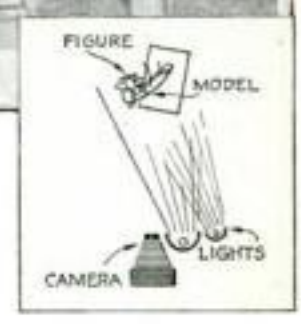
Proper lighting of subject is half the battle—Beginning a new series

By FREDERICK D. RYDER, JR.

CLEAR, sharp photographs are within the reach of everyone who owns a camera, whether it cost a few dollars or several hundred. All you need to do is practice the simple rules of photography outlined in this article and others to follow. By doing so you can learn to take pictures of professional quality.

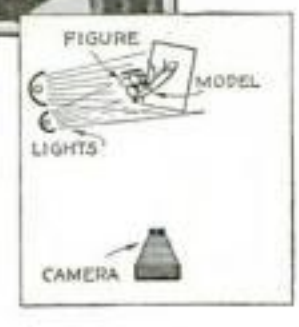
Like the detective who must first find the crime before he can apprehend the criminal, we must first figure out what a picture is before we can study the mechanics of taking it. Every time we blink our eyelids, we are working the shutters on two perfect cameras. Any camera we buy is nothing more than a man-made imitation of the human eye. Without light, both eyes and camera would be useless.

When you gaze with pride at little Junior playing in the sunlight with his toys or stand back to admire the latest product of your home workshop, what do you actually see? Certainly little Junior, no matter how agile he may be, could not crawl in through your eyes and thus register on the cells in your brain. Nothing goes into your eye but light, and the picture formed in your eye is therefore nothing but a light effect. Light reflected from Junior's face, his toys, the grass, and the like goes through the lens of your eye and stimulates the nerves of the retina. The nerves receive certain impulses and transmit them to the brain.



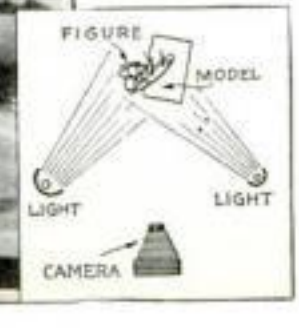
Picture No. 1. **An example of a photo taken with both the lights close to the lens. The result is dull and lifeless.**

Picture No. 2. **A photo of the same subject as in picture No. 1 but with the lights placed beside the man so that the light rays are at right angles to the line of sight of the camera. The result is unnatural.**



How the brain functions to create an image out of these nerve impulses, no one really knows. However, we do know exactly what happens in the human eye insofar as it parallels the action of the camera. Within the limitations of our apparatus, whatever will reflect light to form a picture to the eye also will form a picture that can be taken with a camera.

A picture, being merely a light effect, exists only because of variations in the light values. If every part of the subject reflected to your eye or the camera had the same intensity of light, neither the eye nor the camera would register a picture. You would see, and the camera would record, a blank surface of a shade



Picture No. 3. **A photo taken with the proper lighting. The lights are placed on opposite sides of the subject so that their rays are at 45° to the line of sight of the lens.**

$10 for the Best Photograph

POPULAR SCIENCE MONTHLY *will pay $10 for the most photographically perfect picture submitted by an amateur photographer on or before July 1, 1931. It may be of any subject but must be taken during the months of May or June, 1931. Any type of camera may be used, and the developing and printing may be done by the contestant or by a professional. Mail entries to Photographic Editor not later than July 1. None will be returned.*

¶Here is the first of a novel series of articles especially written to help you take clear, sharp photos, the kind that will cause your friends to marvel and ask where you obtained such a fine camera.

¶Whether you are a home workshop enthusiast endeavoring to get a good picture of something you have built or you are taking a snapshot of your child, your dog, or your home, these articles will help you.

¶Frederick D. Ryder, Jr., already known to POPULAR SCIENCE MONTHLY readers for his model railroad and home workshop articles, will illustrate this series with specially taken photographs.

¶He will show you that taking good pictures with simple, inexpensive cameras is much easier than most people think, and also explain when, why, and how the more complicated cameras are used. Mr. Ryder is not going to discuss the "art" end of photography, but he will teach you to take pictures that are clear, true, and sharp.

¶If you have any questions to ask, Mr. Ryder will be glad to answer them in the magazine, or by mail.

of gray corresponding to the intensity of the light.

A picture must, therefore, be made up of light and dark areas, the lines being merely the divisions between areas reflecting light with different intensities.

No matter how much you may know about the mechanics of a camera, if you don't understand the basic light-and-shadow construction of a photo, you will never take a good picture except by accident.

Fortunately, determining the light and shadow value of things you would like to photograph is quite easy. Whether you take pictures by daylight or use artificial illumination makes no difference; the same rules apply to each.

Before you point the camera and snap the shutter, study the lights and shadows of the subject and discount as much as possible the pleasing effect of color. If a possible subject is attractive solely because of its color effect, don't waste film on it; a picture in white, black, and shades of gray will not do it justice. Try to imagine how the subject would look if shades of gray were substituted for the colors. Remember that the nose on a man's face, for example, appears as a nose in the finished photograph only because the part that sticks out catches more light and reflects it to the camera and also casts a shadow on his cheek or his chin.

A baseball looks round in a picture only if it is properly shaded with the front well lighted, one side not so bright, and the other considerably darker. If the light is directly behind the camera, the baseball would register on the film almost as flat as a piece of white paper. If the light were behind the object, it would register as though it were made of a flat piece of black paper. Under average conditions, always have the light rays making an angle of about forty-five degrees with a line drawn from the camera to the subject. A study of the lights and shadows on the object will show you when to modify this rule.

ALWAYS bear in mind that the human eye will respond to a wider range of light and shadow than a camera. You can, for example, see the detail or lines of objects in very deep shadow while the camera, under ordinary conditions of exposure and development, will record just so much black paper where the detail in the heavy shadows ought to be.

Pictures taken on the beach in strong sunlight often show this effect. Eyes, instead of appearing as eyes, often look like holes burned in a blanket.

Now let's see how all this works out in practice. Suppose, for example, that you wanted to take a picture of a man seated at a table working on a ship model. Other objects in the room probably would be of no particular importance in this case. All you want is a clear, sharp picture of the man and the ship model on which he is working.

My neighbor happens to be working on such a job, so I took my camera over to his house one evening. On the preceding page are reproduced the three pictures that I made. All three are exactly alike in every respect except for the lighting. In fact, I didn't touch the camera at all except to change film and operate the shutter.

Picture No. 1 is dull and lifeless, as though the outlines of the objects were sketched on a gray piece of paper. There aren't any shadows to speak of because the light was coming directly from a point close to the lens of the camera. Such pictures are called "flat."

Of course, even with lighting that produces no shadows, you are bound to get something on the film because the various objects in the picture reflect different amounts of light. Because of this picture No. 1 is, with all its faults, better than picture No. 2, which was taken with all the light coming directly from one side—and the wrong side at that. Such lighting produces harsh black and white pictures. In pictures such as this, details are almost entirely obliterated. Where the man's face ought to be there is nothing but a black blotch with a white dot on it where the tip of his nose caught the light. The ship model hull is nothing but a black shadow. Beginners' pictures often show this fault, technically known as excessive contrast.

THIS picture reproduces by artificial light the effect you get in strong sunlight and is like the snaps taken on the beach in the early morning or late afternoon with the sun's rays striking the subject at right angles to the line of sight.

Picture No. 3 was taken with two sources of light, a strong one and a weak one. The strong light was placed so that its light struck the subject at an angle of about forty-five degrees to the line of sight, and the other light was placed on the other side to give some light in the shadows and thus eliminate the black areas in picture No. 2.

In taking pictures outdoors by daylight, you haven't the control over the position or intensity of the light that you have indoors with artificial light. But if you can't control daylight, you can at least wait till the daylight is right for the job. Take your own home or any other building as an example. Notice how it looks from various viewpoints at different hours of bright and cloudy days, and you will soon spot the time to take the picture.

Proper lighting isn't all there is to photography, but when it is right the picture is almost certain to be a success. Of course, there are many occasions when it is necessary to take a picture under adverse conditions because it isn't possible to improve the lighting or wait for better light. What to do then is part of the good photographer's bag of tricks. None of these tricks are guarded secrets and they will be explained one by one in future articles.

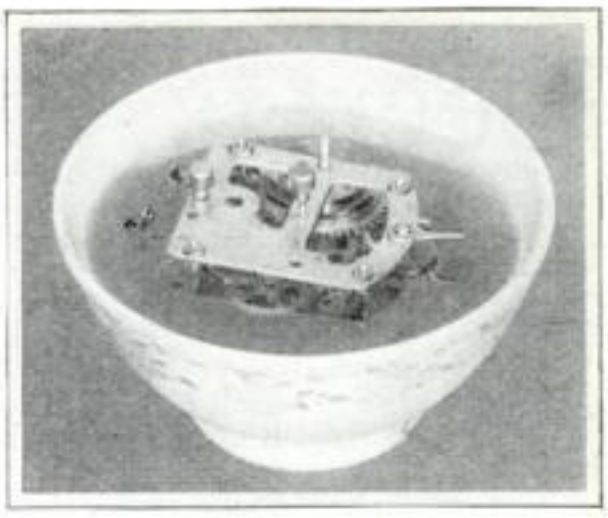
CAMPER'S STOVE IMPROVED WITH SHELF

The front of the shelf can be folded back out of the way, if desired.

With the front closed down, the stove is converted into an efficient warming oven.

WITH the addition of a folding shelf and front piece as illustrated, an ordinary three-burner camper's gasoline stove has several advantages. Its heating efficiency is increased, it does not spatter so much grease around, and it allows biscuits, pies, and other food to be warmed on an unlighted end burner while the other two burners are used for cooking. Furthermore, it serves more effectively and safely as a tent heater when necessary.

Two pieces of galvanized iron are required, one long piece that fits over the top and is bent down about ¾ in. over the end shields of the stove, and a slightly shorter front piece. The two pieces are hinged together, and the front folds back over the top when not in use. Folded, the shelf takes up little additional room in packing.—E. M. and C. J. BRICKETT.



CHEAP CLOCKS RENEWED IN KEROSENE BATH

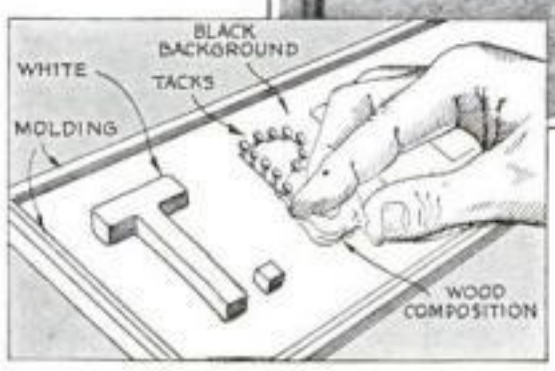
WHEN alarm or other clocks of the cheaper variety come to the end of their usefulness and no longer run, their life can be renewed, unless the spring or some other part is broken, by removing the works from the case and soaking them for a day or so in a bowl of kerosene. If the works are turned about in the kerosene at intervals, the grit and dirt will drain to the bottom.

The face, of course, must be removed; and after soaking, the works should be hung on a string to drain and dry in a place free from dust. This cleaning process can be repeated once a year.—J. W. BAILEY.

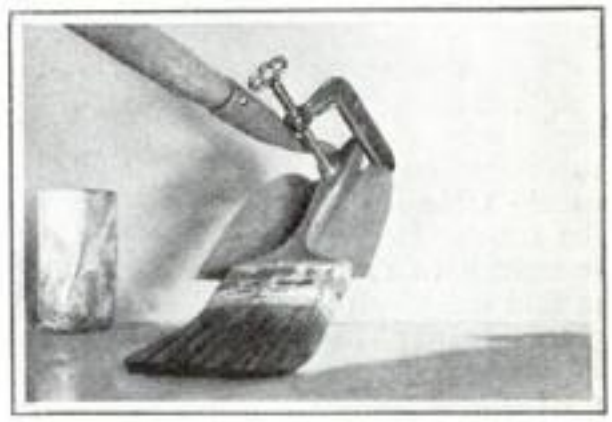
SIGN MADE WITH COMPOSITION LETTERS

EXPENSIVE looking raised letter signs can be made cheaply with the aid of any high-grade wood composition of the type intended to be applied in a plastic state. Paint the background black, draw the letters in outline with a scriber, and along the center of each stem drive a row of carpet tacks, letting the heads project about ⅛ in. Work the wood paste around the tack heads until they are covered; then build up the letters to conform to the scribed outlines.

After the letters have hardened, work them down and round them with knife and sandpaper, and apply two or three coats of outside white paint with a sharp-pointed camel's-hair brush. Fit an appropriate molding around the sign and hang it from a framework of ½-in. pipe, or mount it in any way that will meet your particular needs.—EVERETT A. BROWN.



Raised letter signs like the one above can be made by molding a wood composition paste around tack heads as illustrated at the left.



CLAMPS BRUSH TO HOE FOR PAINTING FLOOR

BY ATTACHING a 4-in. paintbrush to a garden hoe with an iron C-clamp as illustrated above, one home owner saved himself many hours of tiresome kneeling and bending when he undertook to coat the floor of his basement with a dust proof cement paint.—RAY J. MARRAN.

RECORDING YOUR KEYS

THE loss of a particular key, or bunch of keys, often proves to be quite an inconvenience. I find it a good plan to make a blueprint of each key that I have, and under each print I letter the number of the key and the name of the lock company. It is thus easy to have a duplicate key made if necessary. A dozen or more keys can be recorded in this way on a small sheet of blueprint paper which then can be filed for future reference. This kink is especially handy in shops.—D. L. SIVERD.

PRUNE BOX CONVERTED INTO DOGCART

"GIDDAP, Spot! We've got to go to the store for mother." What boy couldn't say that willingly and with a cheerful voice if he had a fox terrier dogcart like the one illustrated at the right?

This cart is made from a prune box 12 in. wide, 15 in. long, and 6 in. deep. The two white pine shafts are 3 ft. long and are set about 8 in. apart; and they are connected 3 in. in front of the body by means of a crosspiece to which is loosely bolted the single-tree. Two back braces from a worn-out coaster wagon are bent to form brackets for the axle. The wheels, 10 in. in diameter, are also from the old wagon. The box is painted green and the wheels and shafts bright orange.—CARL G. ERICH.

Any boy would be proud to be the owner of this fine dogcart; and it consists primarily of scrap parts and a prune crate.

Secrets *of* Successful Gluing

By DONALD G. SAUNDERS

FROM the lumber rack in his well-equipped basement workshop, Frank Bradley drew a short block of scrap wood and held it up for Jack Horland's inspection.

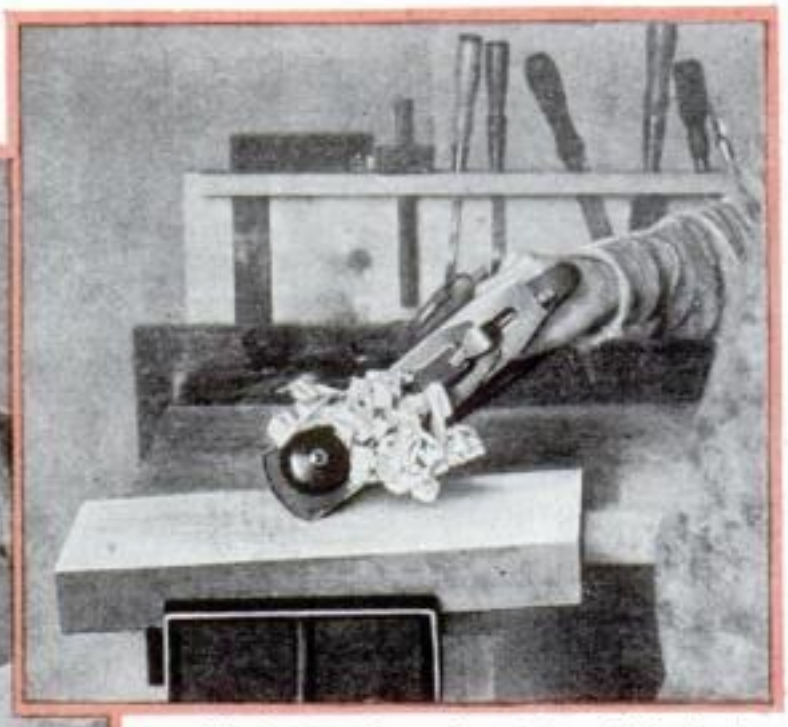
"Dry or not dry?" he demanded.

"That's more than I can tell."

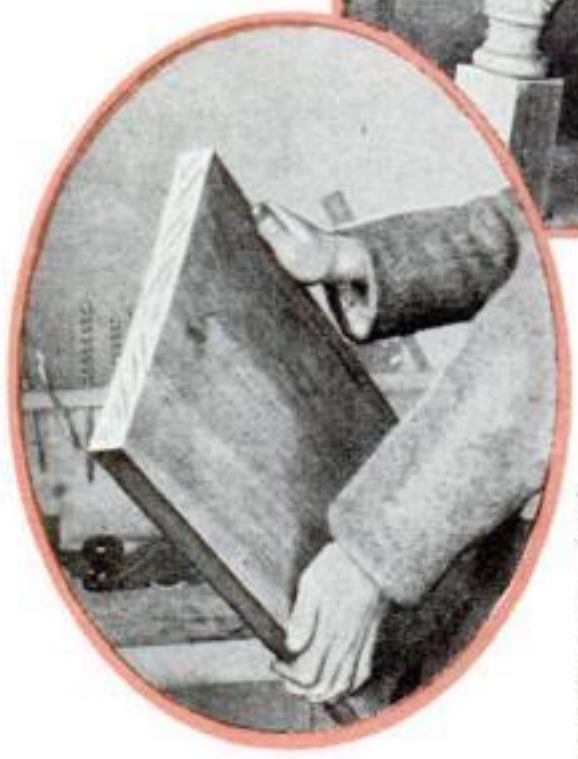
"Then just listen to this." Frank rapped the wood sharply with his knuckles. "Do you hear that ringing sound? It's a fairly good sign that the wood is dry. Now watch this."

Gripping the block in his quick-acting bench vise, Frank ran a fine-set smooth plane over it several times, and a mass of tight-rolled shavings curled crisply into view.

"There's another good sign—when fine shavings cling to the plane. It is evidence that the wood is dry enough. Now, if the wood you had used in gluing up the stock for those sixteenth century table legs had been that dry, you might not have had this trouble."



Wood that gives a fine, close-rolled shaving when planed can be depended on as being dry.



"This joint opened," explained Frank, "because a plain-grained piece was glued to a quarter-sawed piece." *Left:* A piece of warped plain-grain wood.

"No, I suppose not," admitted Horland as he glanced ruefully at the partly turned table leg on the bench. He had brought it to Frank to find out why the glued joints had opened and left cracks that ruined the appearance of the bulbous turning. An enthusiastic amateur woodworker, Horland was making a table for his camp; and, as he had already explained to Frank, he had glued up the stock for the legs with the best cabinetmaker's hot glue. After he had partially turned one leg, he had been compelled to put aside the work to make a long trip for the concern for which he was sales manager, and upon his return he had discovered that the partly finished leg was badly cracked and the blocks for the other legs were also useless because of opened joints.

"It certainly is discouraging," Horland continued, "especially as I told Gregg, the lumber man, that I wanted kiln-dried wood."

"I don't doubt that it was kiln-dried, but it may have been lying for months at the lumberyard in an open shed or an unheated building, where it would be bound to absorb moisture. However, you could have overcome that by keeping the wood in a warm, dry room until you were ready to use it. Are you sure you fitted the joints well?"

"Yes, I took great pains with them."

"Then did you do the gluing in a warm room? Did you heat the wood? Were your hand screws all set and ready so that you didn't give the glue a chance to chill?"

"You have me there. I'm afraid I slipped up on all of those points. But that doesn't explain it to my satisfaction—not in the least," he added, as he thought it over. "If what you say is the right answer, why have some of the joints started and not others? Tell me that."

He shot the question with an air of defiance at Frank, who smiled and deliberated a moment before replying.

"The explanation is simple enough, yet very few amateur woodworkers have ever given it any consideration. To do good work, you have to glue with the grain."

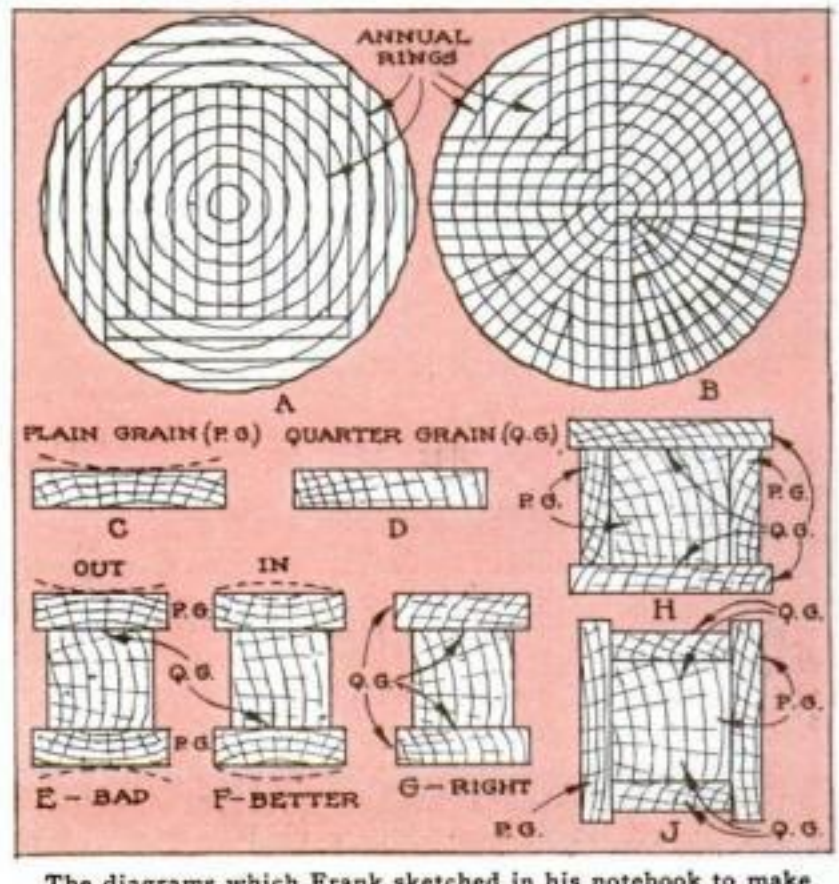
"Glue with the grain!" repeated Horland in astonishment.

"Exactly. And in some cases you glued with the grain by accident. Those joints held. The others didn't. You're lucky you didn't get the table all finished before this happened. When defects appear in apparently well-made glue joints after months or years of use, they are often due to incorrect grain relations rather than to poor glue or gluing. If the grain is not right, internal strains are caused which react directly upon the joint with every change in temperature or humidity."

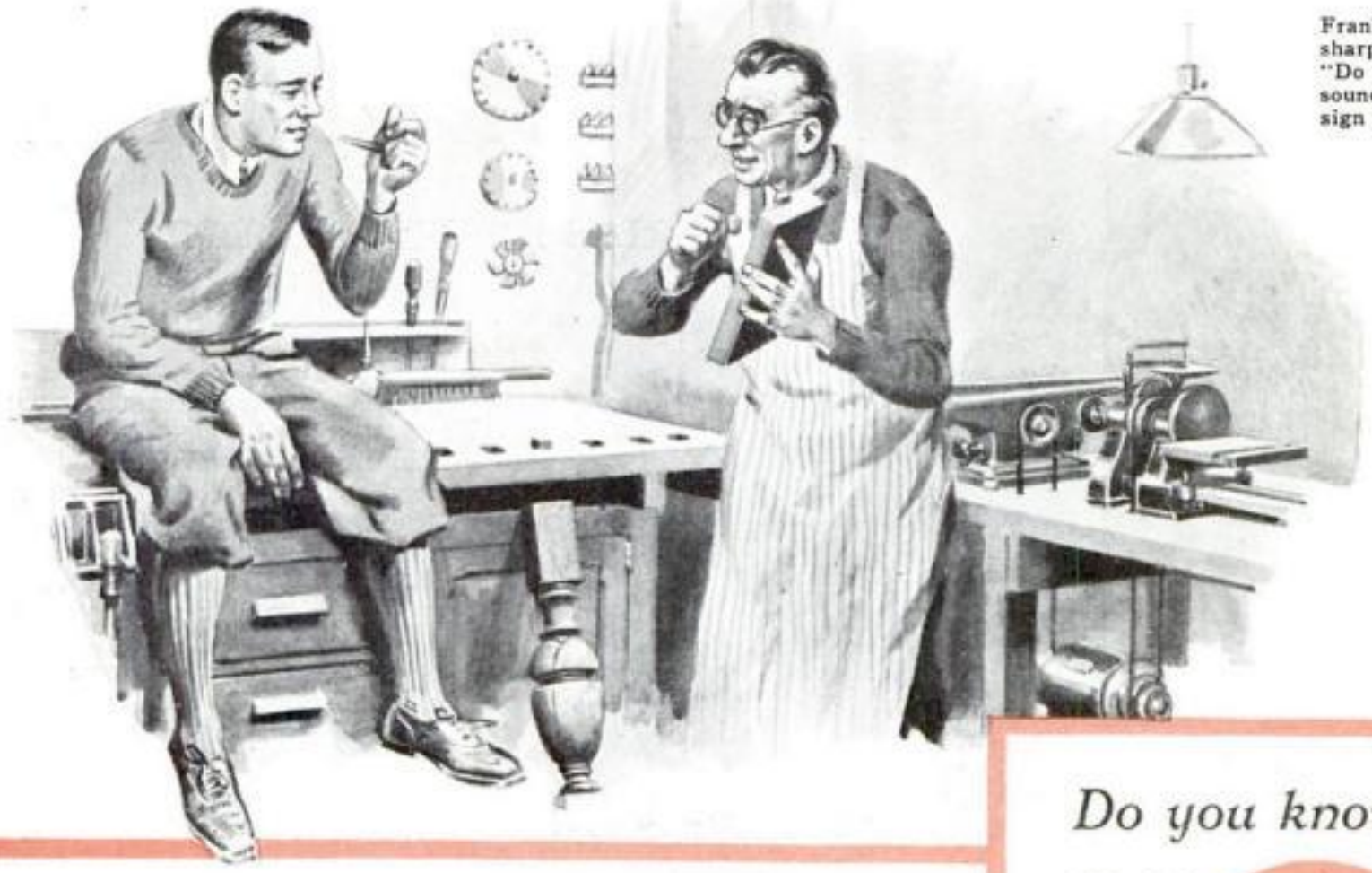
Horland looked mystified. Picking up the table leg, he turned it slowly and studied the grain.

"This joint, which opened up so badly," Frank explained, "is between the plain-sawed face of the core and a quarter-sawed board; and this joint on the opposite side, which looks to be perfect, is between two quarter-grain pieces. You know the difference, of course, between plain- and quarter-sawed wood?"

Frank drew hasty diagrams like those marked *A* and *B* in the accompanying drawings. "The first is plain, slash, or bastard sawing; the second shows four ways in which quarter-grain lumber is sawed. You can see why quarter-sawed



The diagrams which Frank sketched in his notebook to make clear the points regarding plain- and quarter-sawed wood.



Frank rapped the wood sharply with his knuckle. "Do you hear that ringing sound? It is a fairly good sign that the wood is dry."

is more expensive and wasteful, but of course it is much better for fine work."

"Yes, I knew there's a difference. It is very distinct with plain and quartered oak, for instance."

"Then you should be able to tell which is the inside and which the outside of a board. Let's try."

Frank pulled a plain-sawed board from the scrap pile and handed it to Horland.

"The outside would be the side facing the bark of the tree—this side," replied Frank's visitor, as he tapped one face of the board. "The direction of the curve of the annual rings on the end tells me that—and the medullary rays, too."

"That's right. And when a board begins to warp and shrink, which side will be hollow?"

"I might take a fifty-fifty chance and guess—"

"Look at this," interrupted Frank, as he drew a sketch like that at *C*. "It shrinks in such a way that the outside of the board tends to become more or less concave, and the inside convex. A quarter-sawed board"—he drew a diagram like *D*—"shrinks more in thickness, inch for inch, than in width, and it doesn't warp unless one side dries faster than the other—even then, comparatively little. Now, here is the core of the leg with the annual rings making a quarter grain on two opposite sides." With lightning strokes, he sketched the diagram *E*. "I am placing the inside of a plain-sawed board on each of these quarter-grain sides of the core. What happens? When shrinkage begins, both pieces will tend to warp away from the core, and the plain-sawed pieces will shrink more than the quarter grain. This creates heavy strains at the joints and weakens the glue."

"Then turning the pieces over would be much better," Horland commented. "Whatever warping took place would force the edges into closer contact."

Nodding assent, Frank made sketch *F*. "You must bear in mind, however, that the plain-sawed board will shrink faster than the quarter grain of the core, so it is still better to glue quarter-grain pieces to the quarter-grain faces of the core as here—" He drew a sketch like *G*. "In other words, quarter to quarter and plain to plain. In fact, the legs should be glued up in either of these two ways for best results—" and Frank drew *H* and *J*. "Don't forget that the outside face of the plain-sawed wood, as far as possible, is the one to be glued."

"I never realized there was so much to making good glued joints," Horland exclaimed. "It was good of you to explain it all so clearly." As he shouldered the bulky table leg and headed for the door, he added: "I'll put this and the three other blocks in a warm dry place and let them warp and shrink as much as they like for a month or two and then see what can be done with them, because I have other work to go ahead with. You can just bet, too, that I'll be careful how I glue them together again. From now on my slogan will be 'glue with the grain!'"

"That's the stuff," agreed Frank. "You'll find it always pays to take time to do a job right."

This is the second of a series of articles about Frank Bradley and his friends. The first article (P.S.M., Mar. '31, p. 102) was on making mitered joints. Other subjects are being prepared and will be published in future issues.

Do you know—

Why it is necessary to "glue with the grain"?

When boards are sufficiently dry to make good joints?

Which is the outside and which the inside face of a board?

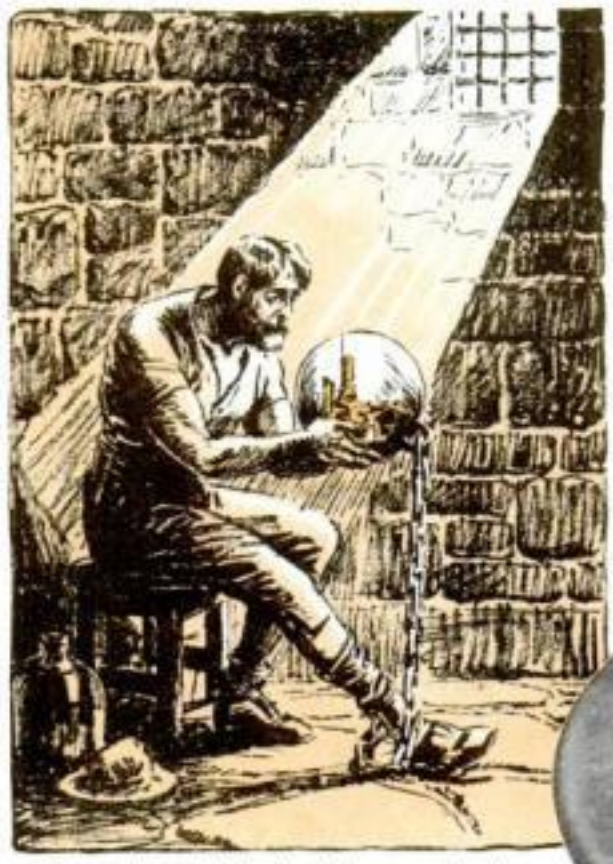
How to be sure a glued joint is going to hold?

In this story Frank Bradley, that genial and expert craftsman who so often helps his neighbors with their home workshop problems, answers all these questions.

Novel Ball-and-Chain Desk Set

Portrays a Prisoner's Dream

By CHARLES HERBERT ALDER



Just what the blacksmith saw when he gazed at the iron ball is realistically depicted in this unique desk set.

HERE is a genuine novelty in desk sets that is easy and inexpensive to make, requires few tools and very little material, and offers the craftsman an opportunity to exercise his skill, ingenuity, and imagination in elaborating the idea as much as he desires. Furthermore, it is one of those rare projects about which you spin a thrilling yarn. But listen—

Long, long ago a poor but worthy blacksmith, who was always making tiny wagons and other toys for the children of his town, was sent to prison for shooting one of the King's deer to keep his family from starving. In prison, thin from hunger and worry, he sat in shivering despair and gazed at the ball and chain locked to his ankle. This very ball and chain had been made in his own shop!

As he gazed at the ball, he fell into a heavy slumber and dreamed he could pick it up and gaze into it as if it were a crystal globe. And in it he could see his shop: a fire glowed in the forge, on the bench was the wagon wheel he had been working on, and a horseshoe was on the anvil.

At last the time came for him to go free, but he found that in a few days his shop and house were to be sold to pay his family's debts. Then he remembered the day he had dreamed that he could see his smithy in the iron ball. It gave him an idea. He would make a ball and chain and present it to the King. The ball would be of glass, and in it would be a miniature blacksmith's shop—anvil, forge, bellows, workbench, tools, and everything.

All that day and all that night he worked, and the next morning, his job finished, he took his gift and hurried to the King's palace, for it was the day of the sale and there was no time to be lost. The King was so pleased with the gift that he ordered the sale canceled and gave a feast in honor of the good and clever blacksmith.

Now, to make a duplicate of the blacksmith's gift to the King, you will need the following materials: 1 small goldfish bowl about 4¼ in. in diameter (the author obtained his at a ten-cent store); 1 base 9 in. in diameter or whatever shape and size you prefer; cardboard about 1/16 in. thick for the floor of the smithy and for the hinge, hasp, and staple plate on the anklet; 3 ft. of heavy cord about ⅛ in. in diameter; scrap wood for the forge, bellows, anvil, workbench, tools, etc.; a celluloid chain, or sheet lead or other material for making a chain; escutcheon pins to simulate rivets; a good grade of glue; and bronzing liquid, gold and silver bronzing powders, black lacquer, fumed oak stain, and red and yellow paint for imitating the fire in the forge.

Although various tools may be used, the only essential ones are a pocketknife, a small hand drill, tweezers, and paintbrushes.

Cut a piece of cardboard 3 in. in diameter, paint it black, roll it up, and put it in the goldfish bowl. With your fingers and a pair of tweezers, unroll the cardboard, and use a stick to glue it in place. It forms the floor of the smithy. All the equipment in the shop is of wood, although the wheel can be taken from a small lead toy. Assemble the pieces, stain or paint each of them as required, and glue them in place.

The hole in the bowl is covered by gluing or cementing on a disk of wood. In this cover drill a number of holes in a circle and glue in the heads of

A sectional view of the glass ball, showing the tiny forge, anvil, hand bellows, bucket, tools, bench, and an unfinished wagon wheel.

rather large escutcheon pins; these represent rivets. The eye in the center of the cover is made by cutting one link of the chain in half and gluing the ends in holes drilled to receive them.

The anklet can be turned from wood, whittled out with a knife, or made from a section of heavy mailing tube. It should be large enough to receive a small inkwell. Mine is 1⅞ in. in diameter, 1½ in. high, and ⅛ in. thick.

The hinge and hasp are each made of cardboard, cut to shape and doubled over around a short length of match stick, which serves as the pin. Glue them on, drill holes for the escutcheon pins, and glue in the escutcheon pins and the staple of the hasp. In the same way, make the plate and staple for attaching the chain. Then use half a link and a small piece of wood to imitate the padlock, and glue it on the anklet.

To fasten the bowl to the base, smear glue where it is to be mounted, set the bowl on the base, and wrap cord around it, gluing the cord as you proceed. When the glue is dry, attach the chain to the ball and the anklet, and glue the anklet to the base.

Paint the back half of the ball, the chain, and the anklet a dull black, touching them up here and there with a little aluminum bronze. Make two small mounts for the pen, glue them in place, and give the base a coat of gold bronze or finish it to harmonize with the surroundings.

Furniture That's Easy to Build

By MARSHALL BREEDEN

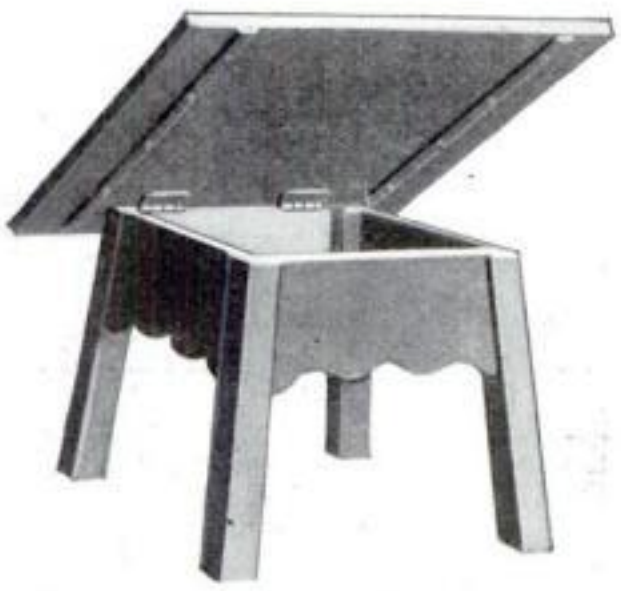


Fig. 1. This cupboard bench can be used as a combination magazine holder and stool.

AMATEUR craftsmen who experience difficulty in obtaining plans for just the type of furniture they desire will do well to turn to commercially made pieces for designs, over-all dimensions, and general methods of construction.

Indeed, woodworkers who exercise a little ingenuity by scouting through furniture stores and gift shops and scrutinizing advertisements, often will find excellent suggestions which can be used in building pieces of their own.

For instance, each of the four pieces of attractive novelty furniture illustrated in Figs. 1 to 4 are commercial designs, yet each can be made easily and inexpensively by the amateur.

A very simple, yet attractive piece is the cupboard bench illustrated in Fig. 1. The top of this bench is 14 in. square and the legs are just 14 in. long, giving the whole piece an appearance of sturdiness.

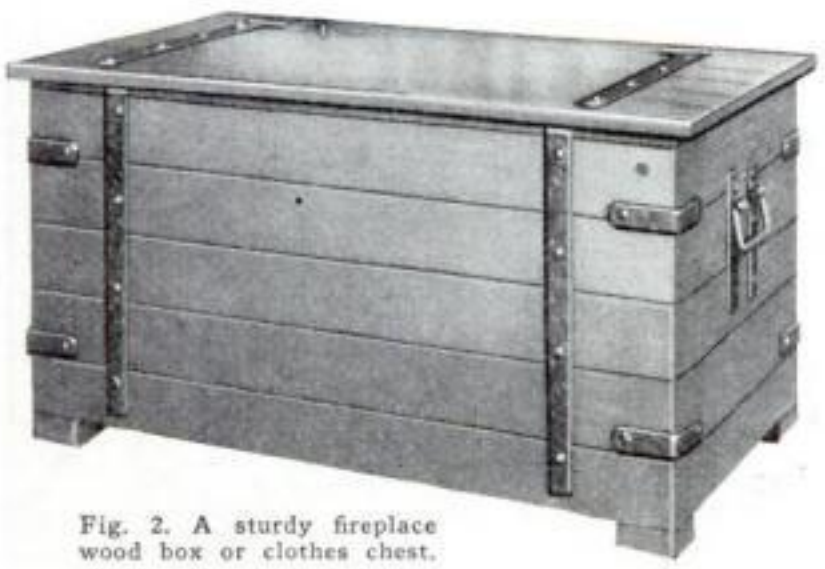


Fig. 2. A sturdy fireplace wood box or clothes chest.

The legs can be cut from 1½ by 1½ in. stock. The top and rails are of plywood.

Being adaptable either as a storage place for clothes or as a wood box for the fireplace, the Spanish design chest illustrated in Fig. 2 forms a useful as well as decorative project for the home craftsman. The over-all dimensions are 22 in. wide, 24 in. high, and 36 in. long.

Strap hinges and corner irons not only add to the attractiveness of such a piece but serve to furnish additional strength. If the chest is to be used for the storage of clothes, a thin lining of cedar would not be amiss.

The Spanish fireside bench illustrated in Fig. 3 is 14 in. wide, 20 in. high, and 36 in. long. The four legs, which are mortised to receive the tenons of the four top rails and two bottom rails, are cut from lengths of 3 by 3 in. stock. Additional strength is obtained through the use of 2 in. wide wrought iron straps around the corners and over the joints between the stretcher and the lower rails. This strap ironing is fastened in place with ordinary lag screws.

The cushion can be made from monk's cloth or a suitable fine burlap and should be left in its natural color. Cotton can be used for the stuffing. Ordinary hemp rope, woven through the holes in the top rails, supports the cushion.

A simple bench for the garden or garage together with two sheet metal lanterns which have been fitted with electric lamps is illustrated in Fig. 4.

Fig. 3. No matter what type of fireplace you have, a Spanish bench such as this will form a useful as well as attractive addition to your living room.

The bench is 12 in. wide, 14 in. high, and 18 in. long. Three boards form the top while 1½ by 1½ in. stock, 13 in. long, is used for the legs.

Lanterns similar to those shown can be shaped from sheet metal, the parts being either soldered or riveted together. (For suggestions as to design and methods of construction see P.S.M., July '27, p. 81; and Apr. '30, p. 81.)

Fig. 4. A neat bench and lanterns for the garden.

Rubber-Band Motor Drives Toy Auto *at High Speed*

By JACK ROOD

All set to let 'er go. Here's a toy that is so simple that it can't get out of order.

THIS little rubber-driven auto racer will go farther and faster than any similar toy the writer has ever purchased, regardless of price. The motor, which is a heavy rubber band nearly twice as long as the car, is so arranged that the car continues coasting after it is completely unwound.

You will be able to gain a good idea of the construction by studying the accompanying photographs and drawings. Turn the torpedo-shaped body from a 3 by 3 by 14 in. piece of redwood, white pine, or other softwood. Bring the front half to a uniform diameter as large as can be turned from the stock, and taper the rear half to the diameter of the dead center of the lathe. Then sandpaper the piece thoroughly. The next step is to plane the bottom flat to within 1 in. of the rear end and saw out the cockpit space.

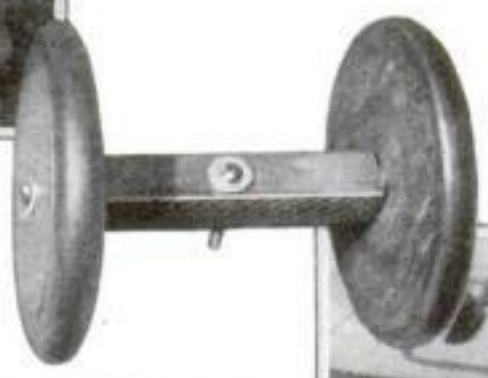
The 3¾ in. diameter wheels can be turned to shape in the lathe by mounting the stock on a screw faceplate. After truing up each disk, round the rim, and cut a groove in one side to give the appearance of a tire.

When all four wheels are turned, paint them yellow; and after they are dry, put them back one at a time on the lathe screw and buff lightly with a rag. Pour a small quantity of gray paint into a shallow dish, bring this up under the wheel (still in place on the faceplate) until the surface of the paint reaches the groove, and turn the wheel slowly until the tire has been painted all the way around. Run the lathe for an instant to throw off the surplus paint and prevent running. Then let the paint dry. While any type of paint may be used, lacquer is to be preferred since it dries so quickly.

A match or nail set in a hole in a rear wheel acts as a winding handle.

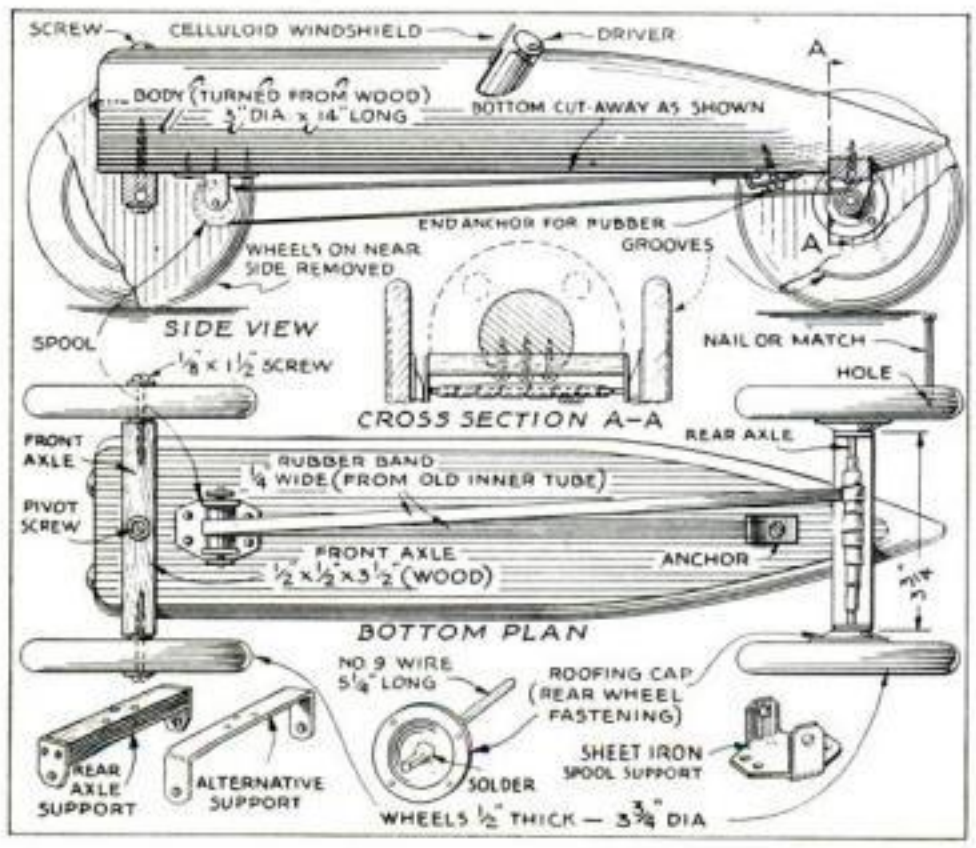
The front wheel assembly calls for a ½ in. square stick 3½ in. long, two 1½-in. roundhead screws to fit the center wheel holes loosely, and four small washers. Another 1½-in. screw and a washer are used for attaching the axle to the body. Paint the axle yellow or gray.

Build up the rear axle support in either of the two ways shown. The method which makes use of a single strip of 20-gage sheet iron is the simplest, and it permits aligning the wheels readily. Drill the ends of the strip to be a loose fit for the No. 9 wire used for the rear axle. Next punch four small holes in the rims of two tin roofing-nail caps. After straightening the axle wire carefully,



Above: The front axle assembly. This is fastened to the body with a 1½-in. screw. All four wheels are 3¾ in. in diameter.

The rear wheels are fastened to the roofing caps with short carpet tacks.



A notch in the body forms the cockpit, and a piece of dowel simulates the driver.

Left: Assembly and detail drawings showing the construction of the toy racer.

Right: Detail of the wooden spool and its support. This assembly is mounted just to the rear of the front axle.

thrust it through the end holes of the supporting bracket (or if the other built-up type of mounting is used, slip the triangular bearing pieces in place) and solder the roofing caps, concave side out, on the axle ½ in. from each end, as illustrated. Now tap the wheels on the wire and drive carpet tacks through the roofing caps to hold them in place.

The body itself should be painted red, green, or some other bright color. Touch the headlights with white or yellow. Indicate the hood louvers and the exhaust pipe with black paint.

For wheels of this size, a rubber band about ¼ in. wide, if cut from an old inner tube, will prove satisfactory. One end is fastened to the underside of the body by means of a metal clip placed close to the rear axle. The band is then carried around a spool mounted as shown in a sheet iron support in such a way that it will rotate freely. Cut off the loose end of the rubber band so that it will come in line with the rear axle if pulled barely taut.

Lap the free end of the rubber once around the rear axle so the band will not slip; then insert a nail or match in the winding hole in the wheel, and, pulling the rubber taut from the axle, wind it up until from forty to sixty turns have been made. Set the racer down on a smooth surface and watch it go!

Greater speed can be obtained by using larger wheels. Oil the bearings well.

Model Plane *with* Wing-Shaped Fuselage

By DONALD W. CLARK

BECAUSE it has what is known as an airfoil or all-wing fuselage, the Burnelli twenty-passenger transport plane forms an unusually interesting study for the model maker. The fuselage is more than twice as wide as the cabin of other transport planes of corresponding capacity, and it is shaped like the section of a wing.

A reasonably accurate nonflying scale model of this plane can be constructed without difficulty by following the accompanying drawings. The fuselage consists of two side walls cut from ⅛ by 1⅝ by 11 in. white pine or other softwood; a nose block whittled from a piece ¾ by 1¼ by 3⅜ in.; two nose filler blocks shaped from pieces 3/16 by 1 9/16 by 1¾ in., which are used to round off the front of the fuselage at each side; and a rear end filling block ½ by ¾ by 1 13/16 in.

Since it is necessary to bend the sidepieces slightly, score a deep vertical groove on the inside of each at a point 4¼ in. back from the nose.

Before inserting the rear end block, it is necessary to cut the two tail supports from pieces 3/32 by 1⅜ by 6⅝ in. These go outside the rear end block and are fastened to the fuselage sidepieces with the aid of two small filler blocks. Another block 5/16 in. square is also fastened between the sidepieces in a position to receive the rear wheel bracket.

The horizontal tail is shaped from a 3/32 by 1¾ by 8 in. piece of wood, and the twin rudders are cut from thin metal.

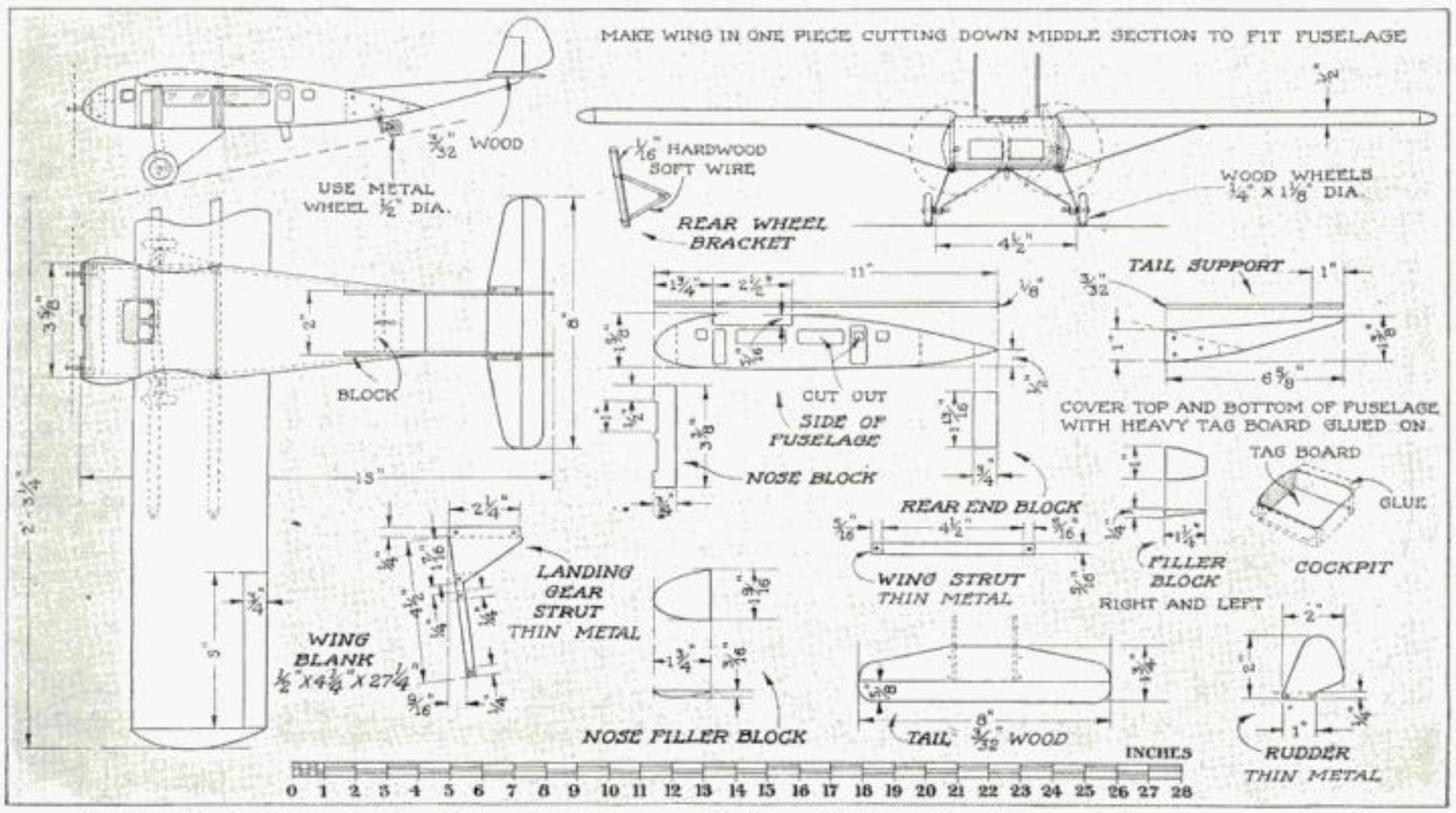
With its all-wing fuselage, this Burnelli plane offers model makers something different in airplane design.

The wing is made in one piece from a white pine plank ½ by 4¼ by 27¼ in. The middle section is cut down as indicated to fit the fuselage.

The landing gear struts, the wing struts, and the two three-bladed propellers are made from thin metal and attached as shown. The main wheels are of wood ¼ in. thick and 1⅛ in. in diameter; the metal tail wheel is ½ in. in diameter and is mounted by means of a bracket of wood and wire made as suggested in one of the detail drawings.

Paint the fuselage, rudders, struts, and wheels (except the tires) dark green, and the wing and the horizontal tail orange.

A few of the dimensions of the full-size plane, it may be of interest to add, are as follows: wing span, 91 ft.; length of all-wing fuselage, 37 ft.; width of fuselage, 12 ft.; and tread of landing gear, 17 ft.



Drawings showing the construction of this easily built scale model of one of the latest Burnelli transport planes. Heavy tag board is used for the top and bottom of the fuselage. The landing gear struts, wing struts, propellers, and rudders are shaped from thin metal.

Clarence E. Mulford *gives plans for building his*

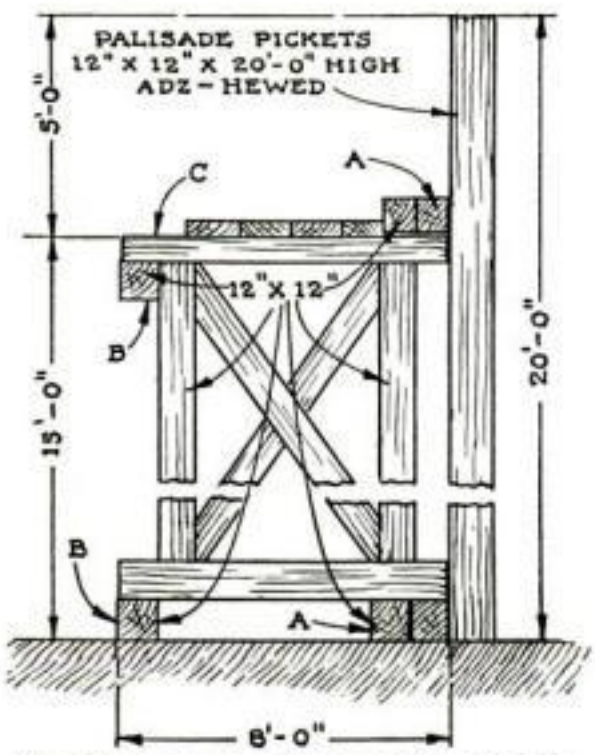
Model of Old Fort Union

Historic trading post on the Missouri where fur trappers and Indian fighters forgathered

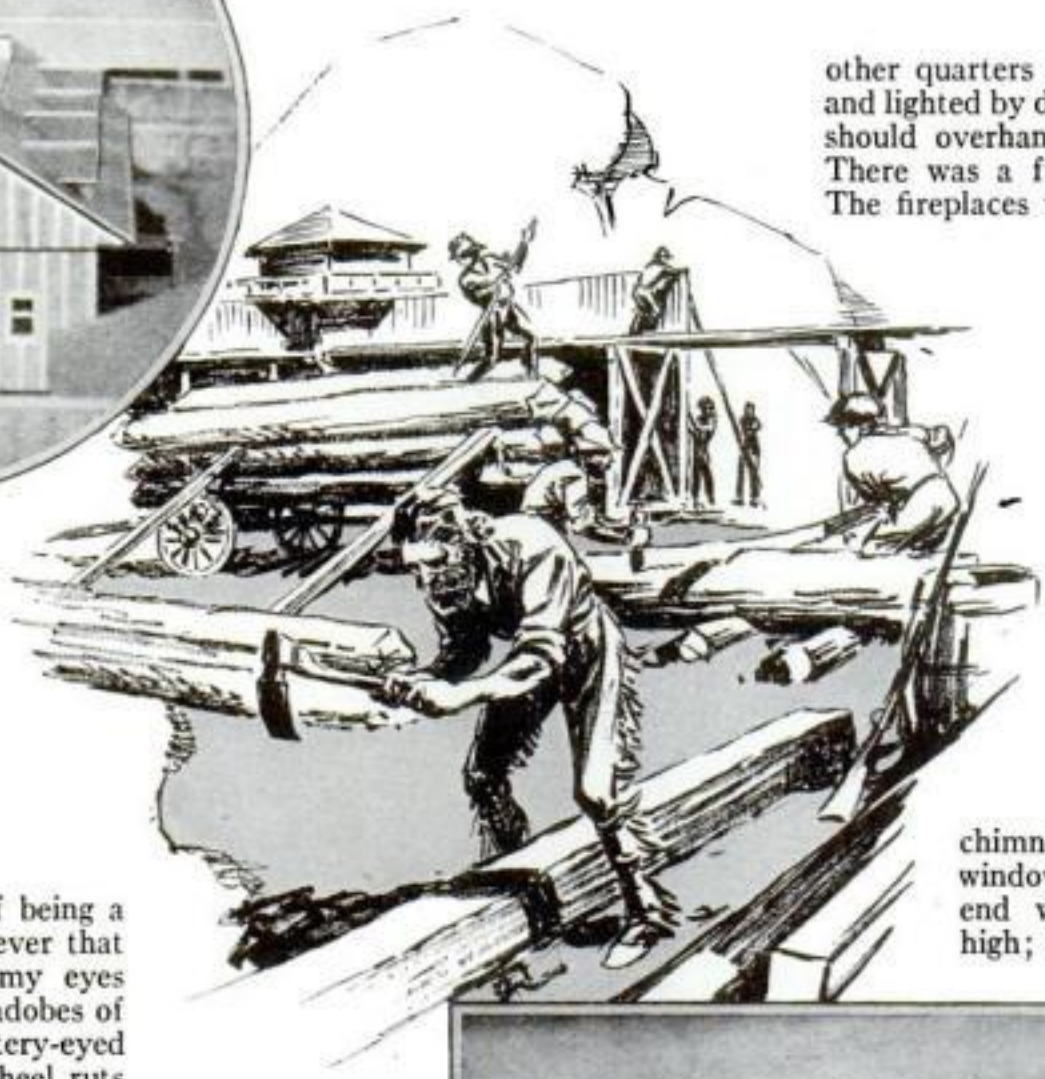
The northeast corner of the fort showing the stone bastion, the cook house, and the factor's house.

THOSE model makers who read last month's introductory article on Fort Union (P.S.M., May '31, p. 91) will understand exactly what my feelings are when I say that I get a great kick out of this kind of work. I have been accused of being a hard-boiled sentimentalist—whatever that means—because tears were in my eyes when I paced off the foundation adobes of Bent's Fort, and because I was watery-eyed when I wandered along in the wheel ruts of the old Santa Fé Trail. To me the ghastly Sink of the Humboldt revealed ghosts of the gold-seekers as they stumbled blindly, despairingly on, starved, crazed by thirst, but magnificently stubborn. But let's get back to model making.

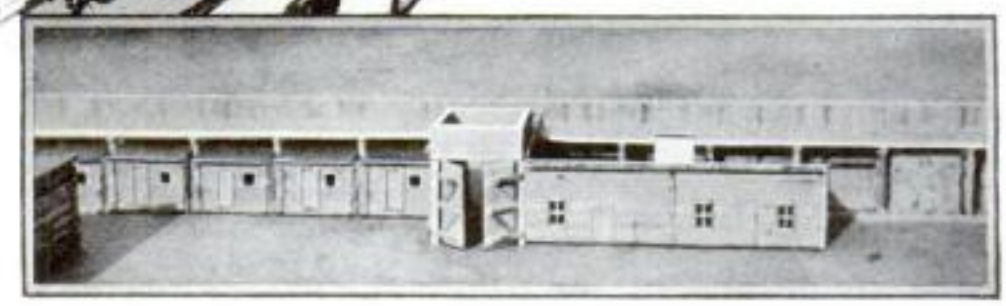
For the base of the model I constructed a strong but light wooden framework and nailed to it a 4 by 5 ft. piece of pressed wood composition board.



How the supporting framework for the palisade pickets and the banquet is constructed.



At right: A view of the southern palisade, trading store, metal shop, gates, and stables.



The various parts of the Fort Union model have been numbered on the accompanying drawings to correspond with the following paragraphs, which will give sufficient data for the construction of a model on any desired scale up to 3/16 in. equals 1 ft. These parts in the model were glued and nailed to the baseboard. The palisade pickets were made of 12 in. square, adz-hewed timbers 20 ft. high. They rested on masonry foundation walls which came up just above the ground. It was this arrangement which made necessary a supporting frame as shown in one of the drawings. The double rails marked *A* and the single rails *B* ran the full length of the palisade, and the upper rails *A* also served as a firing step. All the timbers but the banquet floor were 12 by 12 in.

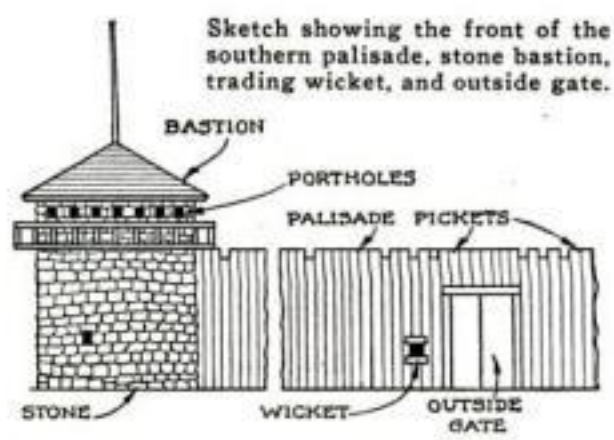
1. Factor's House. A framed building, planked vertically inside and out and weather-stripped. An 8-ft. hall led straight back through the middle, the four apartments opening into it. The southwest room was the home of the factor; the northwest, that of the chief bookkeeper; the southeast, the office; and the northeast, the mess hall. The tailor shop and other quarters were up in the half story and lighted by dormer windows. The eaves should overhang the walls at least 2 ft. There was a front porch with a railing. The fireplaces were in the division walls, back to back, with two-flue chimneys.

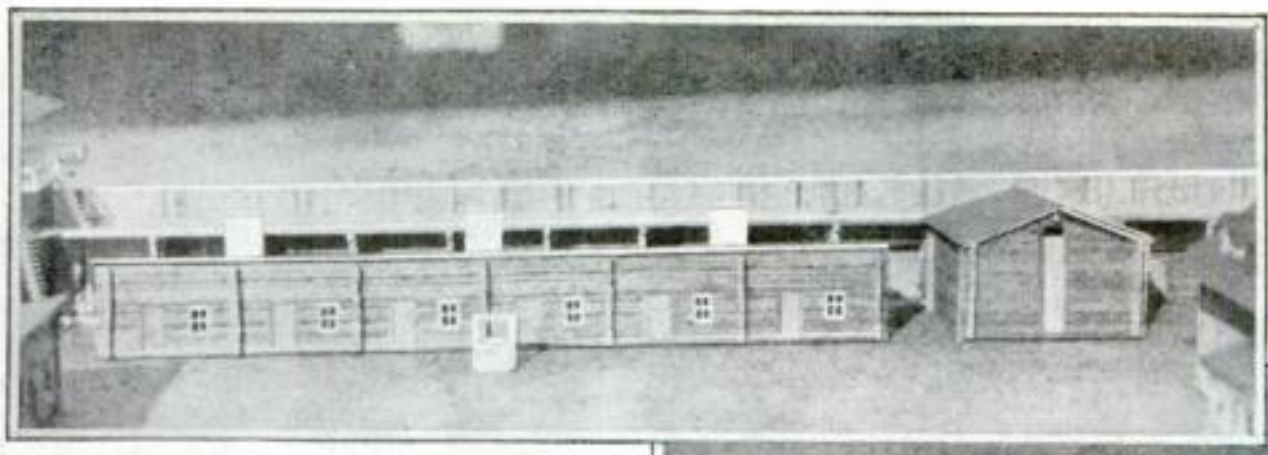
2. Cookhouse. Log walls, the logs notched and crossing at the ends. This is true of every log building in the model. The roof pitched down to the north wall, the upper edge extending in under the roof of the factor's house. A narrow open space lay between the two buildings. In the south wall, a door only; door and two windows in north wall; outside fireplace and chimney in west wall, and no windows. One window in the east end wall. North wall, 9 logs high; south wall, 12 logs high.

3. Magazine. Walls, 4 ft. thick; arched roof, 6 ft. thick. Double doors, outer faced with metal. Use wooden blocks to simulate cut stone, with ends and edges very slightly rabbeted to take the "mortar." Paint color of limestone. Insert thin strips of wood painted white to imitate mortar. This building had a capacity of 50 tons of rifle powder.

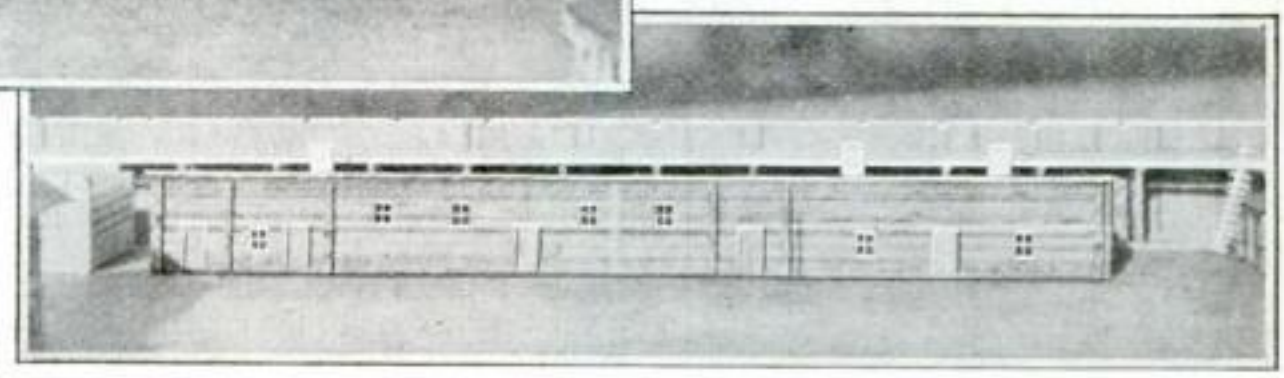
4 and 5. Bastions. Cut stone, same as magazine, 30 ft. high to eaves. Heavy upper floor of planks. Bevel loopholes on the inside. The portholes below were not beveled. They were placed so cannon

Sketch showing the front of the southern palisade, stone bastion, trading wicket, and outside gate.





The apartments and ice house located on the west side of the model. Note well in center.



On the east side of the model is the long building which housed the luggage room, retail store for white men, trade goods warehouse, meat house, and robe-press room.

could sweep the faces of the palisade. Balcony as shown in photographs.

6. Ice House. Log construction. Double-pitched roof, with ridgepole lower than top of palisade. Roof sloped toward the sides. The door was a tall opening running from the base log almost to the ridgepole, strongly framed on both sides. A beam projected over it for block-and-fall. The door is closed in the model by planks laid edgewise inside, and glued to the casing. Side walls, 14 logs high; end walls, 17 logs high.

7. Luggage Room. No chimney. One window, or none at all. Door fitted in frame and glued in place.

8. Retail Store. For trading with white men. Fireplace inside the rear wall. Single chimney, painted same as magazine. One window will do, and one door.

9. Trade Goods Warehouse. Four windows set high up in wall so that piles of goods will not shut off their light. Door as above. No chimney.

10. Meat House. No window, no chimney; door as above.

11. Robe-Press Room. Two single fireplaces inside rear wall, two single chimneys, spaced equally. Door as above. This room held the press and had storage capacity for 3,000 bales of buffalo robes.

THESE rooms *(7* to *11)* were in one long building under one roof. Side walls are better made of long logs, running full length and notched at the proper intervals for the partition walls, the ends of which should come through. Rear wall, 10 logs high; front wall, 14 logs high.

12 to 19. Stables. Built under the banquet. One door each, glued to frame. Small square window high up in front wall. Front wall, 8 logs high; rear, 11 logs high.

20. Two Inner Gates. These were 14 ft. high, of whipsawed planks 4 in. thick. Three heavy cross braces, with supporting timbers running up at angle. The masonry foundations are presumed to follow around this inclosure, making the sill for the gates.

21. Indian Reception Room. Palisade pickets form side walls. Inner and outer double gates. Small window or trading wicket through wall into trade room. During peaceful times and when few Indians were present, both sets of gates were opened. In doubtful times, outer gates were opened, inner gates closed, allowing Indians to enter this entry and trade through trade-room wicket. In dangerous times or when Indians were too numerous or the fort was manned by too few men, both sets of gates were closed, and trading was done through the small wicket in the palisade.

22. Front Gates. Same as inner.

23. Retail Stores. The east half of one log building, a blank partition separating it from the other room. One door, same style. One window in front wall. Front wall, 13 logs; rear wall, 9 logs high. Fireplace in partition wall, back to back with the one in the next room.

24. Trading Wicket. See detail drawing.

25. Blacksmith, Gunsmith, and Tinsmith Shop. The other half of the building. Door, same style. Three windows.

26, 27, 28. Apartments of the Engagés. Three rooms of one long range under one roof, same style as range on other side of fort. Fireplaces back to back in partition walls; double chimneys (see photograph).

29. Apartment for the Post Hunters. Same range, same treatment.

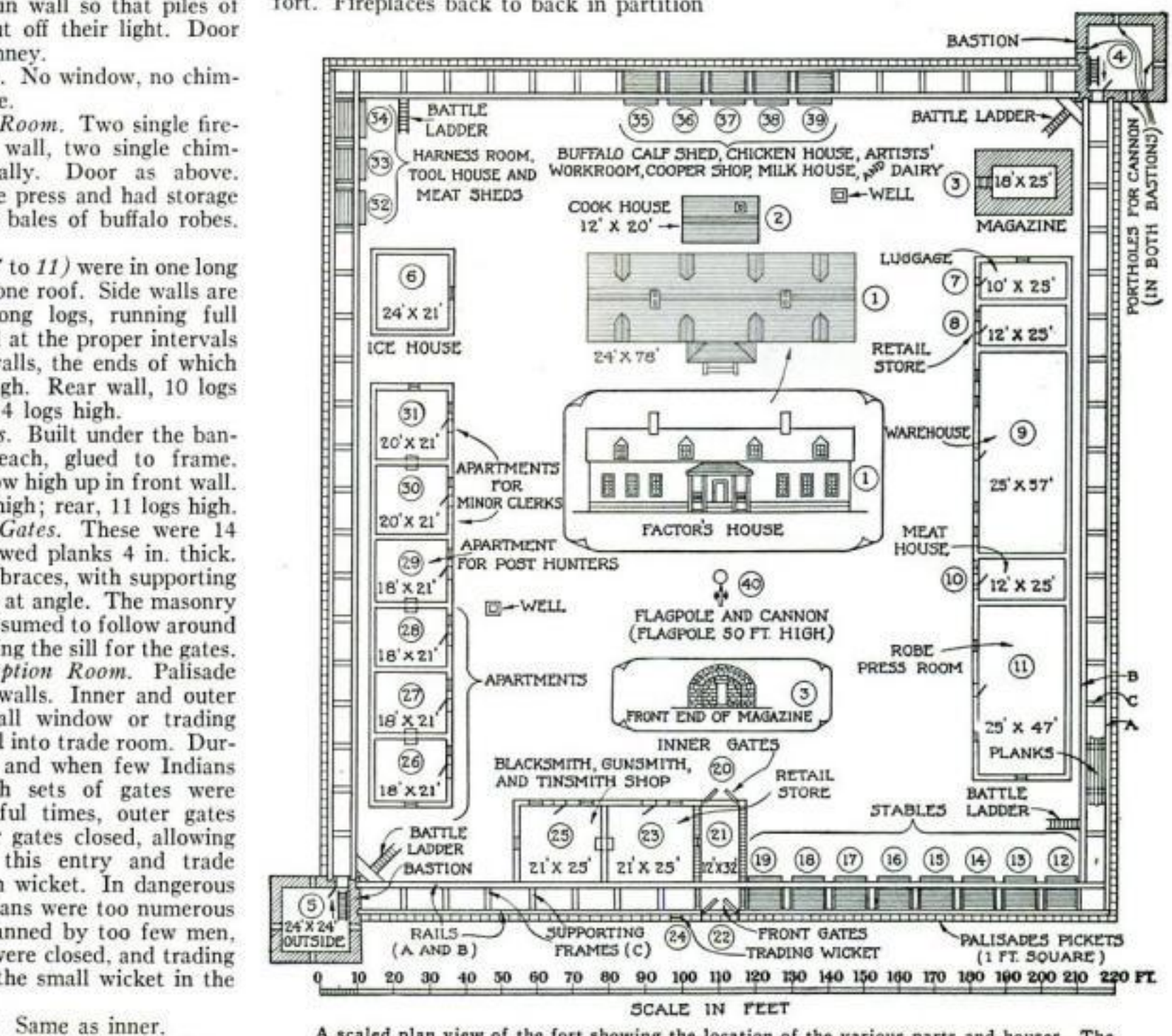
30 and 31. Apartment for Minor Clerks. Same range, same treatment. This entire range of rooms is 13 logs high, front wall; 9 logs high, rear wall. Same style doors. Windows as shown on plan.

32, 33, and 34. Harness Room, Tool House, and Meat Shed. Same as stables, only windows are lower, larger, and glassed.

35 to 39. Buffalo Calf Shed, Chicken House, Artists' Workroom, Cooper Shop, Milk House, and Dairy. Same as last above mentioned.

40. Flagpole and Cannon. Pole 50 ft. high, with double rope. Cannon or carronade trained on inner gates, to sweep entry.

Wells. Where shown; 3 logs high, square, with 2-ft. square opening.



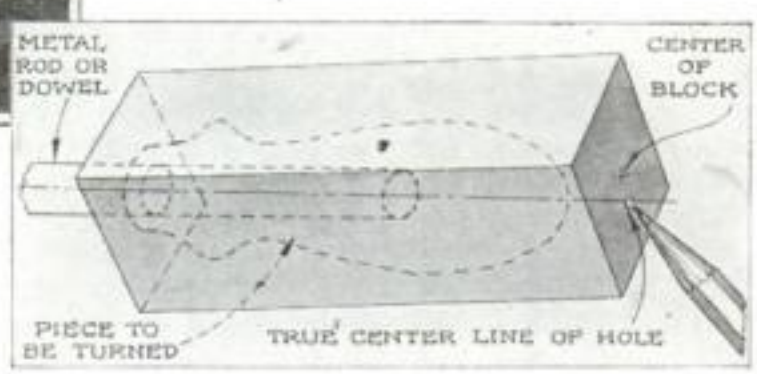
A scaled plan view of the fort showing the location of the various parts and houses. The front palisade of the fort (shown at the bottom of the drawing) faced the south.

LOCATING BLIND CENTERS ON TURNINGS

When the work is turned, the pencil marks a circle, the center of which locates the center line of the hole.

It is frequently necessary to turn a wooden handle, knob, or similar piece with a deep hole in one end. In such cases the outside turned surface often is far from being concentric with the hole because it is so difficult to bore a deep hole without having it run off to one side.

A simple way to get the turned surface true with the hole is illustrated. Run the auger bit or drill into the end of the rough stock to the depth desired, plus an allowance for cutting off. Then stick a metal rod or wood dowel of the right size into the hole, and clamp the other end of the rod in the vise. Rotate the block while holding a pencil against the upper end at a point quite close to the apparent center. A tiny circle will be drawn, and the center of this circle is exactly in line with the true axis of the hole. Punch this "blind" center and place the work in the lathe, with the dead center resting in this punch mark.—F. D. R.



Sketch illustrating the method. If a rod is not handy, the work may be rotated backwards on the drill used.

INEXPENSIVE HUMIDIFIER FOR TOBACCO JARS

A five-cent glass salt shaker containing a rolled wad of ordinary white blotting paper makes an efficient, clean humidifier for tobacco jars. Merely immerse the loaded shaker in a bowl of water until it has soaked up moisture and wipe the outside of the shaker dry so that particles of tobacco will not adhere to it and clog up the holes.

This improvised, inexpensive air-dampener will be found superior to a sponge, as it will not "squish" a large quantity of water on the tobacco, lose its moistening properties quickly, or get gummed up with tobacco grains.—E. J. Beck.

KEEN PLANE IRON TRIMS HAND BOUND VOLUMES

If you bind your own magazines or do any work which requires a number of sheets of paper to be trimmed uniformly, you can obtain professional looking results with an ordinary plane blade that has been sharpened to a keen edge.

The trimming should be done when the first glue coat on the back has almost set and just before the back is to be rounded. Clamp the volume as shown between two boards at least 1½ in. thick, the rear board being slightly higher than the front one. Let the plane iron rest flat on the true, smooth edge of the front board, and make cutting strokes the whole length of the book. Take care not to dig in with the edge of the blade, and sharpen it frequently on an oilstone.—B. K.

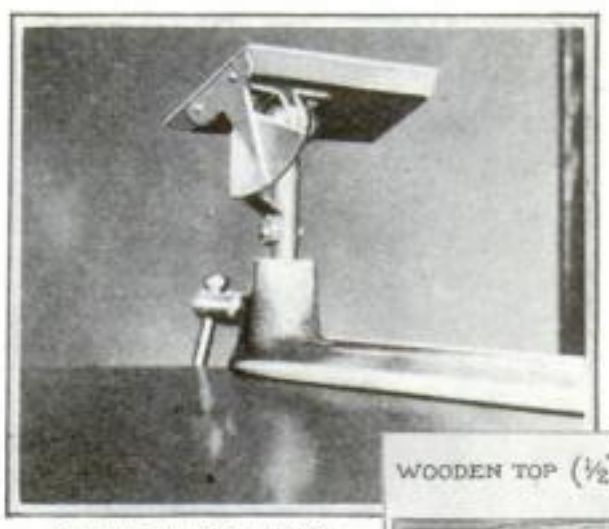
ADJUSTABLE REST FOR GRINDING TOOLS

Built to fit the rest holder of your wood turning lathe, this simple tool grinding attachment makes it possible to obtain the same angle each time a tool is ground.

No dimensions are given for the rod since they depend on the lathe. File the rod for about ¾ in. at the top until it is only ¼ in. thick, and drill a hole through this portion for the pivot bolt. Drill another hole 2 in. from the top for the bolt which fastens the arm to the rod. This arm and the pivot brackets are made of 1/16 in. thick iron and are ½ in. wide. The pivot brackets are screwed to the wooden top in the positions shown in the drawings below.

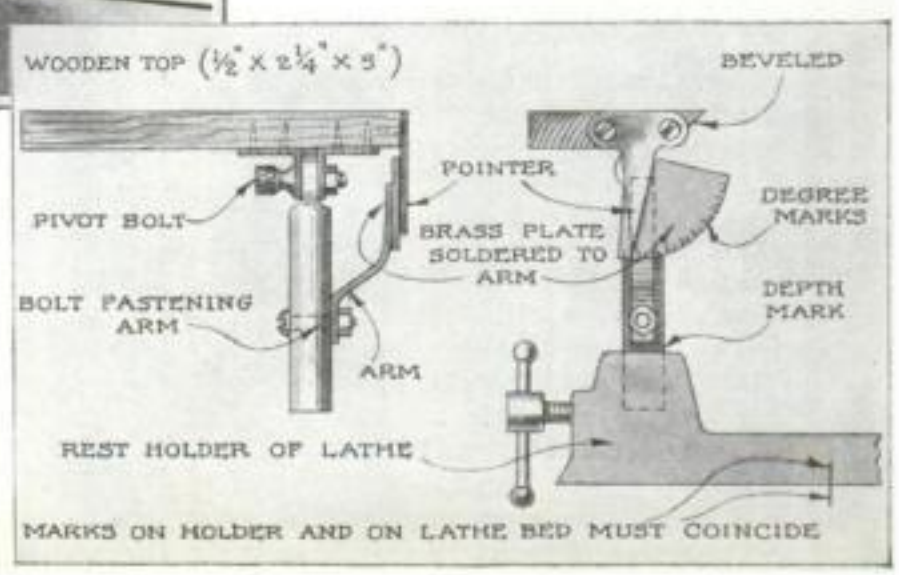
The angle-indicating plate is cut from sheet brass and soldered to the arm. The pointer, also made of brass, is fastened to the end of the wooden top with two brass screws.

Marks should be placed on the rod, the holder, and the lathe bed as indicated in the drawings so that the rest may be set each time at the same height and distance from the wheel.—Burl Knutson.



Rear view of the angle-indicating tool guide showing the arm, plate, pointer, and two pivot brackets screwed to underside of the top.

When cutting thin wood stock, such as inlays, on a jig saw, better results can be obtained if a jeweler's metal piercing saw is used instead of an ordinary jig saw blade.



How the grinding rest is constructed. The dimensions of the rod are not given, as they will vary with the dimensions of the lathe.

How Will My New House Look?

Being purely a mechanical process, this method makes it possible for anyone to sketch a perspective of his new house.

This easy step-by-step method of making a perspective view from ordinary plans gives you the answer to this question

By J. D. GILBERT

HOME builders who are not accustomed to reading blueprints will often experience difficulty in visualizing how the new house will look. They cannot form a clear mental picture of the house from the individual floor plans and elevations. Such being the case, desirable changes which should have been drawn into the plans are not thought of until the house is in the last stages of construction, when it may be either impossible or costly to make the desired alterations.

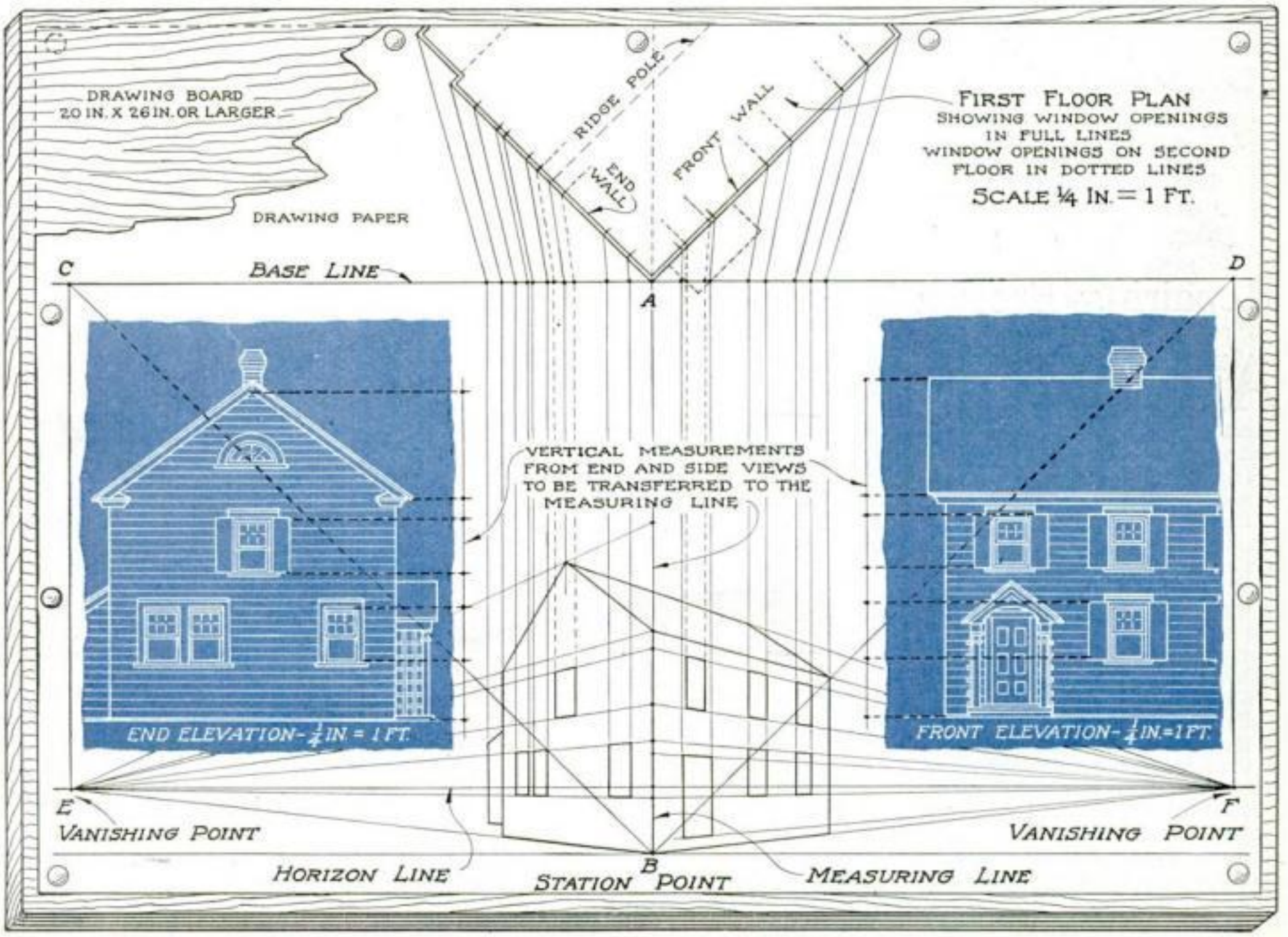
It is the purpose of this article, without giving any more of the technicalities of perspective than are absolutely necessary, to describe a simple yet accurate way of making a perspective that will be as easy to understand as a photograph.

The sketch obtained by this method will be merely a skeleton outline in perspective with the window and door openings accurately located, but the amateur builder should experience little difficulty in sketching in free-hand the eaves, door frames, and other similar details. If desired, the grading, shrubbery, and any other points in the landscaping also can be sketched in to complete the effect.

Assuming that builder's drawings or blueprints (usually drawn to a scale of ¼ in. equals 1 ft.) are on hand and that a suitable piece of drawing paper (not less than 20 by 26 in.) is in place on the drawing board, we are ready to proceed.

Step No. 1—Draw a vertical line in the middle of the paper from the top to the bottom.

Step No. 2—From the builder's floor plans make an angularly arranged drawing



How your drawing paper should look when you have completed the accurate perspective outline of the house. With this much supplied mechanically, it is an easy matter to put in the details and dress up the sketch by roughly outlining the landscaping.

or tracing of the left end and front walls as shown. Locate all door and window openings carefully. Place this plan drawing at the top of the paper with the lower corner *A* on the vertical center line.

Step No. 3—Draw a horizontal line across the paper through point *A*. This is the "base line."

Step No. 4—Scale down 50 ft. (on a ¼ in. equals 1 ft. scale this will be 12½ in.) along the vertical center line from the point *A* and locate point *B*. This is the "point of sight" or "station point." Draw a horizontal line through point *B*, giving the "line of sight."

Step No. 5—At a short distance above *B* (to represent the level of the eye) draw a second horizontal line, which is the "horizon line."

Step No. 6—From the "station point" *B* draw two 45° lines diverging upward until they intersect the "base line," giving points *C* and *D*.

Step No. 7—Draw vertical lines extending downward from *C* and *D* until they intersect the "horizon line." These intersections locate the "vanishing points," and are marked *E* and *F*.

At this point we are ready to begin laying out our perspective sketch.

Step No. 8—Draw lines, converging at *B*, from all corners of the plan and the window and door openings. These lines should be drawn as far as the "base line," and the points of intersection clearly marked.

Step No. 9—Project vertically downward from the points located on the "base line" in the preceding step.

Step No. 10—Place the builder's side and front elevations at any convenient place to the right and left of the line *AB* and proceed to take vertical measurements from the ground up for the heights of roof lines and the tops and bottoms of windows and doors.

Step No. 11—Lay off these measurements on the line *AB*. This line forms the near corner of the house and is called the "measuring line."

Step No. 12—Project lines from these points on the "measuring line" to their respective "vanishing points," details on the end being located by lines drawn to "vanishing point" *E* and those on the front by lines drawn to *F* (see drawing). The intersections of these lines with the lines projected downward from the points on the "base line" locate the corresponding points on the perspective sketch.

It is a simple matter then, using the perspective lines and points thus obtained, to block in the outline of the house, window and door openings, and so forth with firmer lines.

Our diagram, with the instructions for making it, is intended for producing only a skeleton perspective, but by the addition of the details by eye, this can be made into a complete three-dimension drawing of the house as it will look when it is completed.

With all the details sketched in and the landscaping indicated, the sketch shows just how the new house will look when it is completed.

The shutters, window frames, and other similar details are added to the skeleton outline by eye.

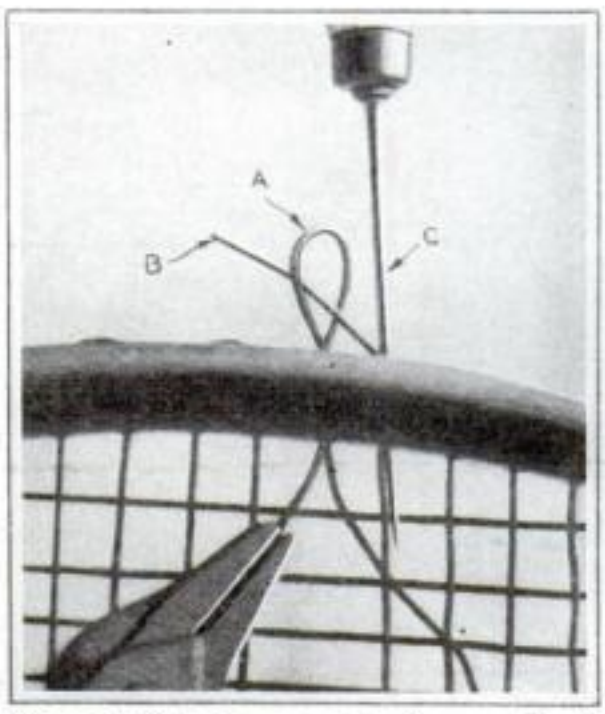
Repairing Broken Tennis Racket Strings

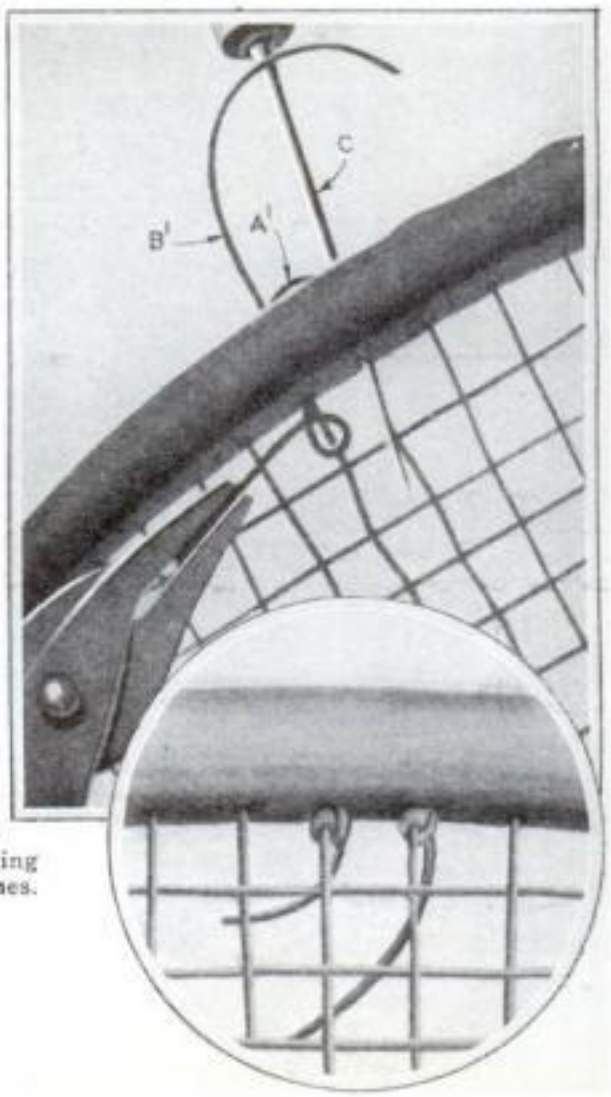
A BROKEN string in a tennis racket is an unfailing source of annoyance. It is quite possible, however, to insert a new length of gut in a manner that will neither affect the playing qualities nor leave unsightly knots on the outer edge of the racket.

The first step is to splice a new piece of gut, marked *A* in the first photograph, to one end of the broken string *B*. Do this by drawing *A* and *B* together in the hole in the racket's rim and pulling the short end of *A* with pliers. The end *B*, however, should first be pulled tight and held with an awl as shown.

When this is done, weave the new gut under and over the main strings already in the racket until it is on the same side of the rim as the other end of the broken string; then tighten it and wedge it with an awl as shown in the second photograph. Next, the end of the new string, now indicated as A^1, is passed through the same hole with the other end of the broken string B^1 and a simple hitch made around B^1, B^1 is then tightened, wedged with an awl, passed through the same hole as A^1 and fastened around A^1 with a simple hitch. The two hitches will appear as shown in the smaller photograph at the right.

The excess gut should be removed with a sharp knife.—JAMES E. RICE.

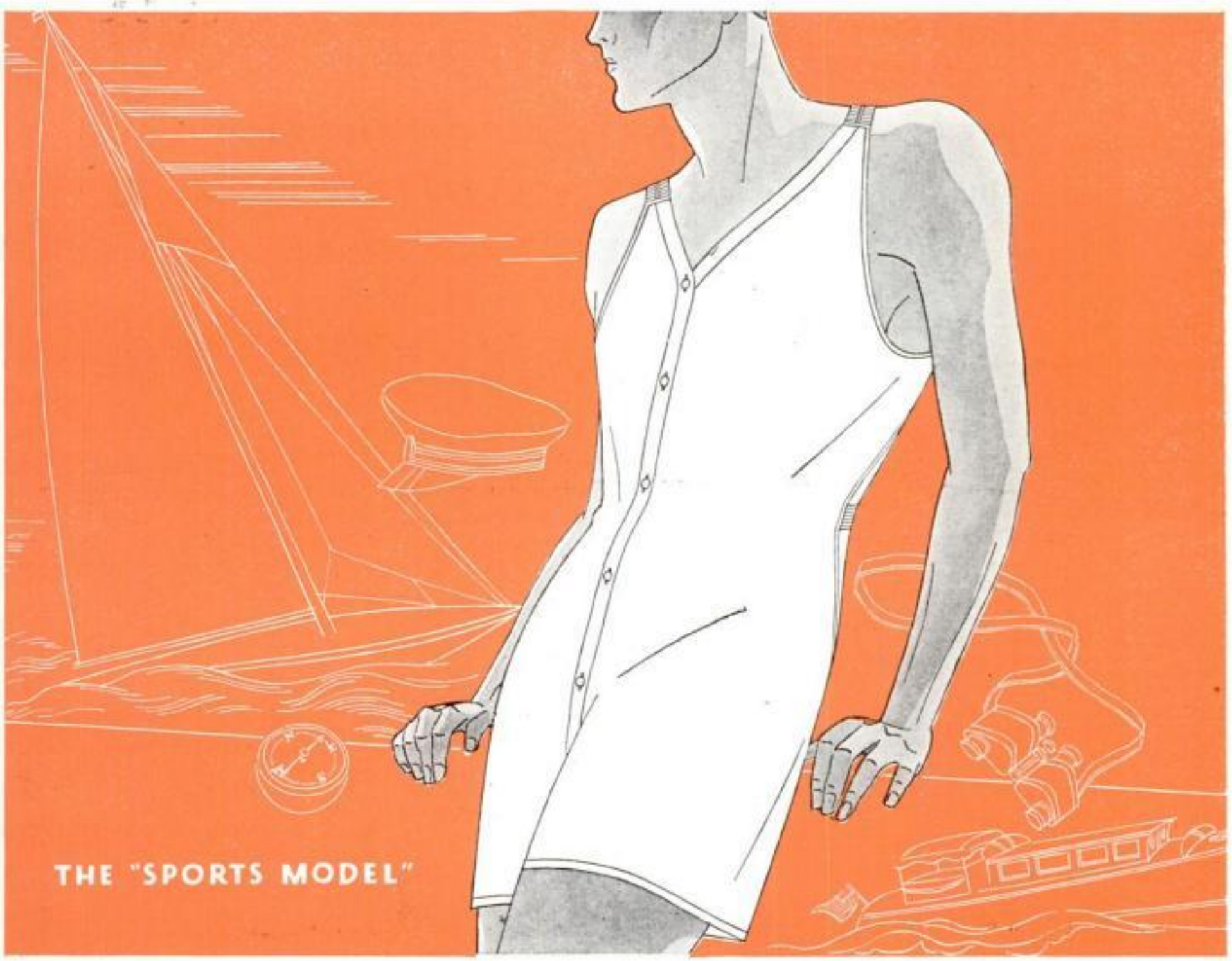




Above: Splicing in new gut. *Above, right:* Fastening new gut on other side of racket. *Right:* The hitches.

What a Chorus of Glee goes up!

What a Union Suit for $1.00



B. V. D. has put the Good Old Dollar back on a pre-war basis as legal tender for quality and comfort underwear.

It won't buy you more than a shampoo and shave . . . a taxi meter spins it away in no blocks at all—but when you put it into this new B. V. D. "Sports Model" union suit—your dollar becomes a high hat purchasing agent!

What a union suit it buys! It's a "Sports Model" from the cut of its shoulders to the flare of its trackman's trunks. It's a low cut model . . . snug where it follows the cut of your frame . . . free where you want plenty of room for active limbs and rippling muscles.

It's made of B. V. D's famous nainsook—a fabric as cool and refreshing to your skin as the ping of a needle shower. It takes a beating from a wash tub and comes up smiling every time—every stitch intact and every button in place. There are two models; one with Double Reinforce Back and one with Blouse Back; Leg Opening.

It's a grand dollar's worth of Union Suit. See it at your dealer's and look for the B. V. D. label—the absolute guarantee of underwear smartness, style and service.

B·V·D

Reg. U. S. Pat. Off.

. . . and even the famous "U-1," the biggest selling Union Suit of all time . . . is now $1.25

Announcing Kodak Competition

$25,000 in prizes *for United States alone for pictures made in May, June, July, August. Your simplest snapshot may win as much as* $14,000.

1,000 Prizes for United States

SIX PICTURE CLASSES

YOU may submit pictures of *any* subject in this contest. Prizes will be awarded in 6 classes, and your entries will be placed for judging in the classes in which they are most likely to win.

A. *Children.* Any picture in which the principal interest is a child or children.

B. *Scenes.* Landscapes, marine views, city, street, travel or country scenes, etc.

C. *Games, Sports, Pastimes, Occupations.* Baseball, tennis, golf, fishing, gardening, carpentry, etc.

D. *Still Life and Nature Subjects, Architecture and Architectural Detail, Interiors.* Art objects, curios, cut flowers, or any still life object in artistic arrangement, any nature subject, etc. Exteriors or interiors of homes, churches, schools, offices, libraries; statues, etc.

E. *Informal Portraits.* Close-up or full figure of a person or persons, excepting pictures in which the principal interest is a child or children. (See Class A above.)

F. *Animals, Pets, Birds.* Pets (dogs, cats, etc.); farm animals or fowls; wild animals or birds, either at large or in zoos.

$25,000 in U. S. Prizes

GRAND PRIZE: Bronze Medal and $2,500

141 PRIZES IN EACH CLASS

For the best picture in each class	$500
For the next picture in each class	250
For the next picture in each class	100
For each of next 5 pictures in each class	25
For each of next 133 pictures in each class	10

(847 prizes, totaling $16,330)

STATE PRIZES FOR CHILD PICTURES

For the best child pictures made in May and June and entered from each of the 48 states, also the District of Columbia, Hawaii and Alaska:

First Prize, each state	$100
Second Prize, each state	50
Third Prize, each state	20

(153 state, territorial prizes, totaling $8,670)

International Awards

The best picture in each class from each country automatically enters the International Competition to be judged for later awards at Geneva, Switzerland.

GRAND AWARD: Silver Trophy and $10,000

SIX CLASS AWARDS: Best picture in each class, a Gold Medal and $1,000.

* * *

Total U. S. Prize Money	$25,000
International Awards	16,000
Prize Money for rest of world	59,000

NOTE that one picture may win a $500 class prize, the $2,500 grand prize for U. S. A. . . . plus a $1,000 international class award and the $10,000 international grand award . . . a total of $14,000 for a single snapshot.

ONE hundred thousand dollars in cash for simple snapshots like those you make—and only *amateur* picture-takers may compete.

Kodak International $100,000 Competition requires no special experience . . . no photographic skill. The awards will be given for picture *interest* only.

Easy to Enter, Easy to Win

This contest is planned to find the world's most interesting snapshots. Pictures will be grouped in six separate classes covering every subject.

The owner of a Brownie, a Hawk-Eye or the simplest Kodak has the same chance to capture a prize as users of costly cameras.

Special Prizes for Child Pictures

Read the split-up of the $100,000. In U. S. A. alone, there are 141 prizes in each of the six picture classes . . . plus the U. S. Grand Prize of $2,500. There are 153 extra prizes in a special "half-way" contest for child and baby pictures made during May and June, the first two months of the competition.

First-prize winner in each class automatically enters the international judging at Geneva, Switzerland, where the awards will total $16,000.

A simple snapshot may win you as much as $14,000 . . . plus medals, a trophy and world-wide fame!

Famous People acting as Judges, Patrons

Photography is the universal language that brings nations, peoples, closer together and makes for international goodwill.

In recognition of this fact, famous people from all over the world have freely consented to act as patrons and judges of this friendly international competition.

Rear Admiral Richard E. Byrd, *Chairman of Judges*

Mary Roberts Rinehart, foremost authoress, *Judge*

Rudolf Eickemeyer, famous photographer, *Judge*

Howard Chandler Christy, celebrated artist, *Judge*

Kenneth Wilson Williams, editor of "Kodakery," *Judge*

International $100,000 *for Amateur Picture-Takers*

Tune in for news of the Kodak contest over N. B. C. Red Network every Friday evening, 10:00 p.m. Eastern daylight saving time. Pacific Coast program, 9:30 p.m. Pacific time.

For pictures of prize-winning kind, use Kodak Film in the familiar yellow box, or the new Kodak Verichrome Film in the yellow box with checkered stripes.

European princes, oriental rulers . . . presidents and premiers, makers of history . . . leading figures in society, science and the arts . . . such celebrities are sponsoring this important event.

Winners of the United States prizes will be determined by a committee of five distinguished judges whose portraits appear at the bottom of the opposite page.

Lay in a supply of film today. Enter as many pictures as you please . . . as often as you wish. Clip the entry blank below. And enter to win!

Read these simple rules for U. S. A.

1. This contest is *strictly for the amateur.* Any resident of U. S. A., Hawaii or Alaska is eligible, excepting individuals and families of individuals engaged in the manufacture, sale, commercial finishing or professional use of photographic goods.

2. Contest starts May 1, closes August 31, 1931. (Also see No. 14.)

3. An entrant may submit *as many pictures* as he pleases and at as many different times as he pleases; provided that the pictures have been *made on or after* May 1, 1931, that they are mailed under postmark dated *not later than* August 31, and that they reach Contest Office not later than September 7, 1931. (See No. 14.)

4. Any Kodak, Brownie, Hawk-Eye or other camera and any brand of film, chemicals and paper may be used in making pictures for this contest. A contestant need not own the camera. The finishing, of course, may be done by his dealer. Pictures may be made from roll film, cut film or film pack negatives. But pictures made from plate negatives are not eligible.

5. Both regular-sized contact prints and enlargements are eligible. No picture is to measure *more than 8 inches* the long way. Prints shall be made from unretouched negatives only. *No coloring* or artwork of any kind shall have been done on either negative or print. *Prints shall be neither mounted nor framed.* Do not write even your name on either front or back of your pictures.

6. Enclose an entry blank with each lot of pictures. Mail entries to Prize Contest Office, Eastman Kodak Company, Rochester, N. Y. Use the entry blank on this page, obtain others from dealers, copy the form, or write to the Prize Contest Office for a supply.

7. *No entries can be returned.* All mailings are at owner's risk. *Do not* send negatives with entries but be sure they are in your possession and *hold them* ready to send on request.

8. All pictures will be *judged solely on general appeal*—the interest they arouse. Photographic excellence or technique will not be the deciding factor in determining the prize winners.

9. The decision of the judges shall be final. In the event of a tie, the advertised award will be paid to each of the tying contestants.

10. Each prize-winning picture, together with the negative, and the first and sole rights to the use thereof for advertising, publication, or exhibition in any manner, becomes the property of the Eastman Kodak Company.

11. Winner of first prize *in each class, including winner of U. S. Grand Prize,* will automatically enter the International Competition.

12. Although no entrant may win prizes on more than one picture, he may win *several* prizes with the one picture. Naturally, the *more pictures you send in, the greater the chance that one of them will win a prize—or prizes.*

• • •

The following additional conditions apply to the offer of prizes for the best child pictures made in each state, during May and June, 1931.

13. To be eligible for a prize in the Child Picture Contest, a picture shall fulfill the requirements of Class A, Child Pictures.

14. Special State Child Picture Contest closes on June 30, 1931. Entries must be mailed under postmark not later than that day and must reach Contest Office not later than July 7, 1931. All entries in Child Picture Contest, including winners, remain eligible for further prizes in Class A at the end of the general contest.

Important! Do not specify classes into which pictures should go. Each picture will be placed in the class in which it is most likely to win. • So that judges shall not know the names of contestants, entries will be filed numerically and each entry acknowledged by a postal card bearing its number. *Please do not* write about entries. • The Eastman Kodak Company may offer to purchase desirable pictures even though they do not win prizes. • Winners will be notified as soon as possible after the judging.

Entry Blank—*Clip it Now!*

Mail blank with your entries to Prize Contest Office, Eastman Kodak Company, Rochester, N. Y. Do not place your name on either the front or back of any picture.

*Name*_____
(Please Print)

*Street Address*_____

*Town and State*_____

*Make of Camera*_____

*Make of Film*_____ *Number of pictures accompanying this blank*_____

P.S.6.

New Ideas to Aid Car Workers

Fig. 1. With grease and a plumber's force cup, shallow dents can be taken out of body.

THE common method of removing dents in the auto body is by pounding from the inside with a soft hammer. To do this it is almost always necessary to take out a large section of the upholstery to get at the back of the dent.

Figure 1, above, shows a way to do the job that will work in some cases, and if it does a large amount of time is saved. If the dent is shallow, smear the surface with cup grease. Then apply a plumber's rubber force cup to the center of the dent and after expelling the air, give a quick jerk, which should remove the dent.

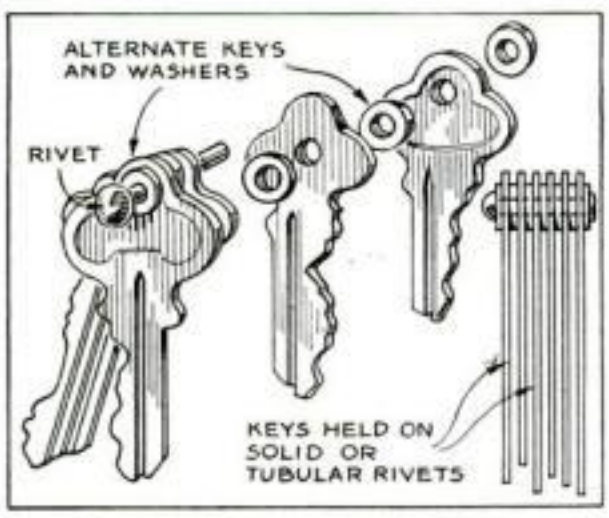


Fig. 2. Your keys won't rattle while car is in use if kept snugly on a rivet with washers.

SO LONG as there are auto thieves to steal cars, it will be necessary to use keys to lock them. Keys are, however, a nuisance. Unless the auto key is kept with the rest of your keys it is easy to leave it home. On the other hand, if the keys are kept on one ring or chain, they rattle against the dash when the car is in motion and may scratch the finish.

Figure 2, above, shows a simple way to keep the keys together so they can't rattle. Each key is separated from the next on the rivet by a small washer. Do the riveting so they can be turned without too much friction. When they become loose, after being in service a while, a blow with the hammer will tighten them again.

POPULAR SCIENCE MONTHLY awards each month a prize of $10, in addition to regular space rates, for the best idea sent in for motorists. This month's prize goes to Chris Christensen, Council Bluffs, Ia. (Figure 1). Contributions are requested from all auto mechanics.

OVERHEAD valve mechanism, when worn, has a tendency to become noisy. This applies more particularly to older models. With overhead valves, as with other types, the most annoying noise is that produced by a single valve mechanism that is a trifle farther out of adjustment or is worn more than the others. The whole mechanism can produce a considerable amount of noise without being annoying if the noise is steady and uniform.

Figure 3, below, shows the use of an auxiliary spring that can be fastened to each rocker arm to prevent play in the push rod and cam. By careful adjustment of the valve stem clearance and the use of these extra springs, the noise is reduced.

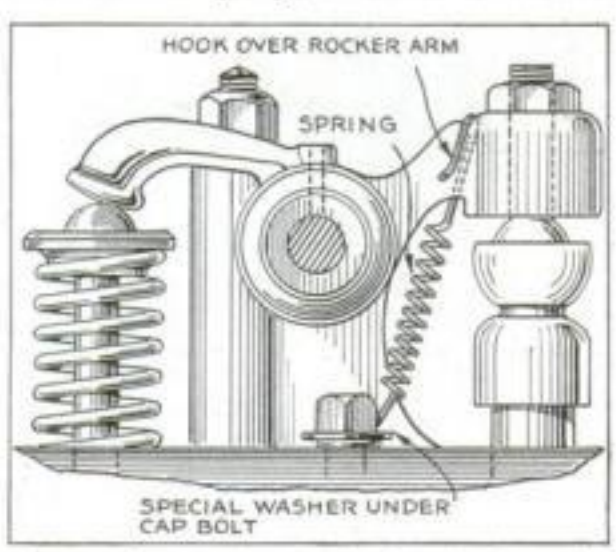


Fig. 3. An auxiliary spring fastened to each rocker arm on overhead valves will stop rattle.

INJECTING a small amount of kerosene into the air intake of the auto motor will make it smoke voluminously. This fact can be utilized in testing to find leaks. A test of this type often is extremely useful when you are troubled with exhaust gas leaking from the muffler getting into the body of the car.

With the motor running and the car outside where the light is good, squirt a little kerosene into the air intake and immediately look for leaks. Wherever there is a leak, you will see smoke coming out as shown in Fig. 4, below.

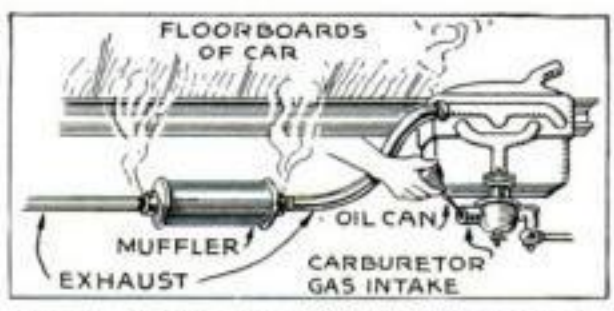


Fig. 4. Smoke from kerosene squirted into the air intake will reveal leaks in muffler.

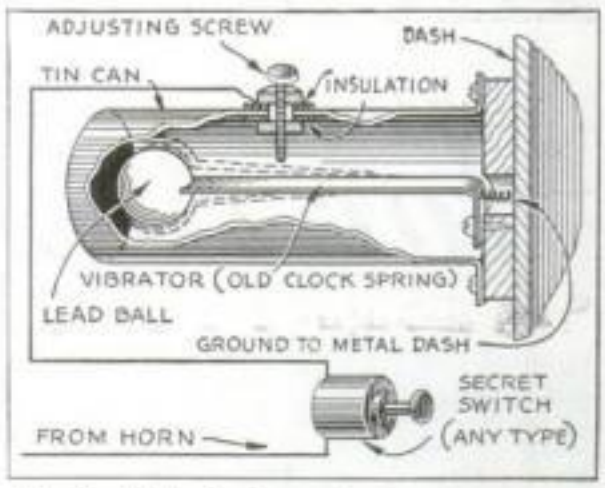


Fig. 5. This simple mechanism turns your horn into an alarm signal if car is touched.

FIGURE 5, above, shows how to build a device that will cause your horn to blow in a steady series of toots as long as it is being vibrated in any manner. If the secret switch is thrown when you leave the car, nobody can so much as step on the running board without causing the horn to start tooting a warning. The material needed to build this device consists of a tin can, a piece of spring taken from an old clock, a lead weight, a machine screw with a couple of nuts, and two leather or fiber washers. The ball shape of the lead weight is unimportant. You can flatten a piece of lead pipe and fold it over several times to make a suitable weight. The whole device can be attached to the back of the metal dash.

When you have it set up and wired as shown, turn on the switch and adjust the screw so that it does not quite make contact with the side of the spring. Then any motion of the car will cause the weight to vibrate and close the circuit.

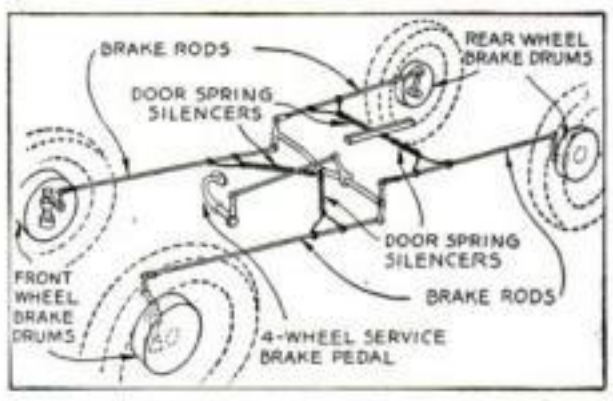
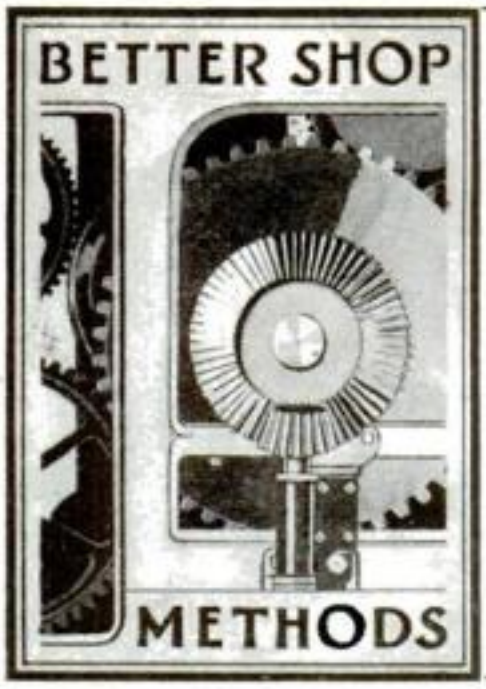


Fig. 6. Old screen door springs can be adjusted to your car to stop brake rattling.

BRAKE mechanism of the mechanical type becomes noisy when the wear has been sufficient to allow play at the clevis joints. Figure 6, above, shows the use of screen door springs or other coil springs to eliminate this rattling.

The diagram shows a suggested method of applying, but of course this can be varied to suit the particular car. The trick is to get the spring just tight enough to prevent any play at the loose joints and yet not so stiff as to cause additional wear or increase the pressure necessary to apply the brakes.

On long trips, when a rattle of this type develops, it is often possible to eliminate it for the duration of the trip by the aid of strong string with ordinary rubber bands to give the tension.



How to Reduce Costs by Reclaiming Tools

Tips on mills, counterbores, and reamers

By HECTOR J. CHAMBERLAND

WHAT can be saved in even a small machine shop by reclaiming dull, worn, and damaged high-speed tools is surprising. In fact, it amounts to far more than anyone would imagine without a record of the actual figures, as was pointed out in a previous article (P.S.M., May '31, p. 98).

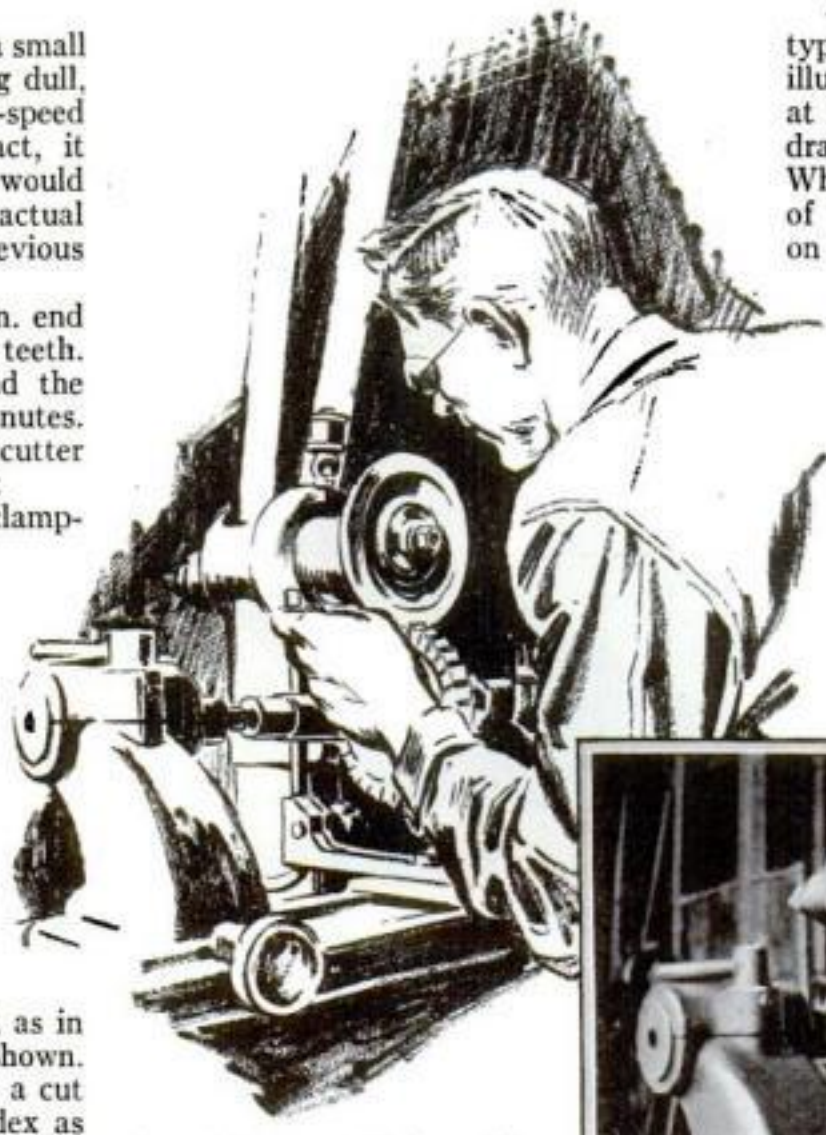
Let us take, for example, a 1¼-in. end mill with three or four broken end teeth. This tool originally cost $6.60, and the maximum salvaging time is 45 minutes. The procedure in restoring such a cutter to first-class condition is as follows:

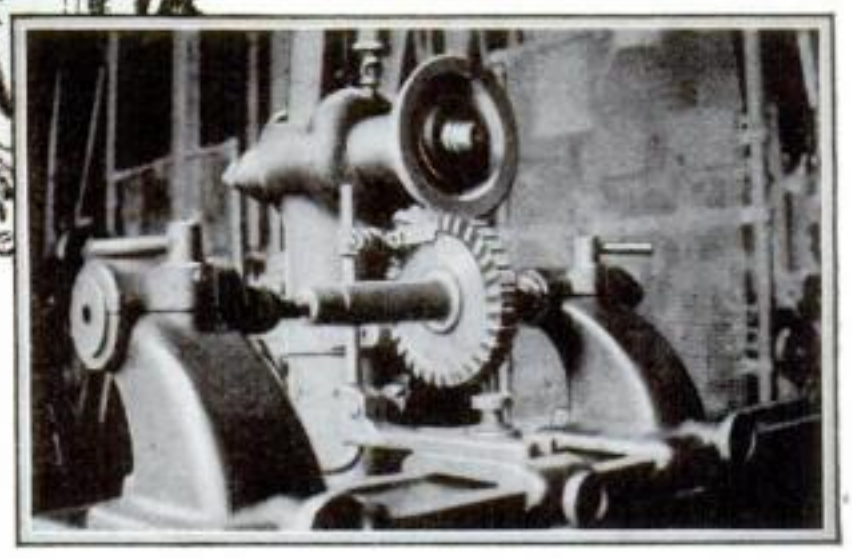
The damaged section is cut off by clamping the cutter in the vise on either the surface or the cutter grinder and using a 6 or 7 by ⅛ in. elastic wheel, as shown at *A*, Fig. 2. The end is then concaved either in the lathe, using the high-speed attachment of the tool-post grinder, or in any other machine equipped with an internal grinding fixture, as illustrated at *B*. The special arbor shown at *E* is generally in stock; if not, one should be made, as it is indispensable for grinding the peripheral teeth of end mills where the center has been removed, as in the case of the broken end mill shown.

With an elastic wheel 4 by ⅛ in., a cut is next taken free-hand at each index as shown at *C*. The mill should be held at an angle so as not to grind into the peripheral teeth. If the tool is under 1 in. in diameter, a wheel 1/16 in. thick should be used instead of ⅛ in. The teeth are then relieved to an angle of approximately 15° as at *D*. This operation is followed by giving the usual 2½° clearance.

The counterbore is another tool which often can be salvaged at a profit. The correct way to make a counterbore is with a removable pilot; still, we find many of the solid type. A broken pilot, however, is no sign the tool should be scrapped. Simply hand-rough the mill as at *A*, Fig. 3; then hold it in a draw-in chuck in the lathe or true it up in the chuck of the internal grinder, and with a 46 K wheel or equivalent, 2 by ½ in., grind the pilot to size and face it at the same time, as shown at *B*. Change to an elastic 2 by 1/16 in. wheel and cut in a recess as at *C*.

Side milling cutters of the latest type will stand a deep recutting of the top teeth, as the side teeth are extra long. Such tools are made to standard dimensions for width, and these should be retained as far as possible; but owing to a slight clearance towards the bottom, the thickness will be reduced as the top teeth are gradually ground away. The mill will not cut more than .002 in. undersize even after the length has been reduced by 1 in. Figure 1 shows the set-up for recutting the top teeth of side mills.





A periodic reconditioning will lengthen the life of your high-speed tools. *Right:* Fig. 1. Set-up for recutting the top teeth on a worn-out side mill.

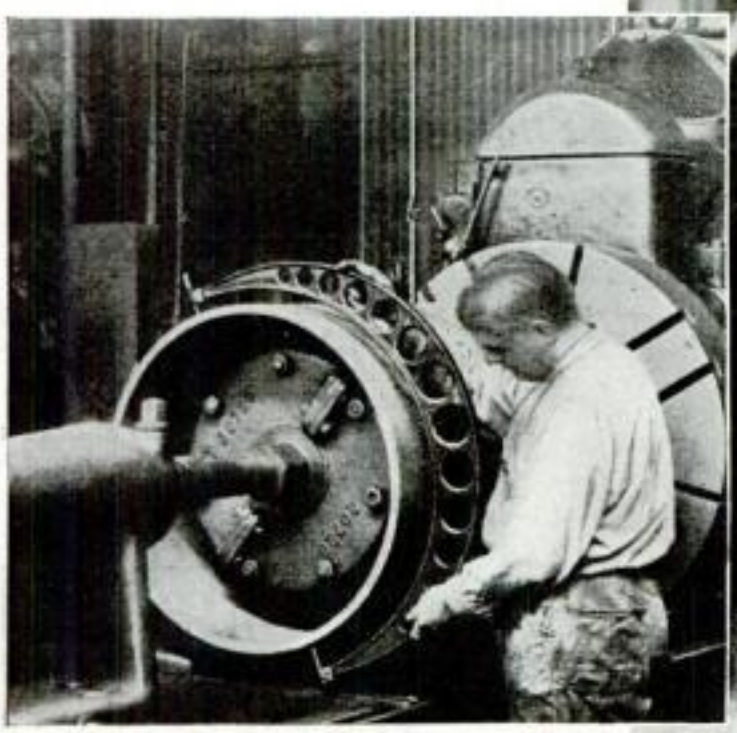
If side mills are given care by keeping the peripheral teeth sharp, they will be practically worn out by the time the side teeth need recutting, but if this has to be done, the operation is the same as in the case of the shell end mill discussed in last month's article.

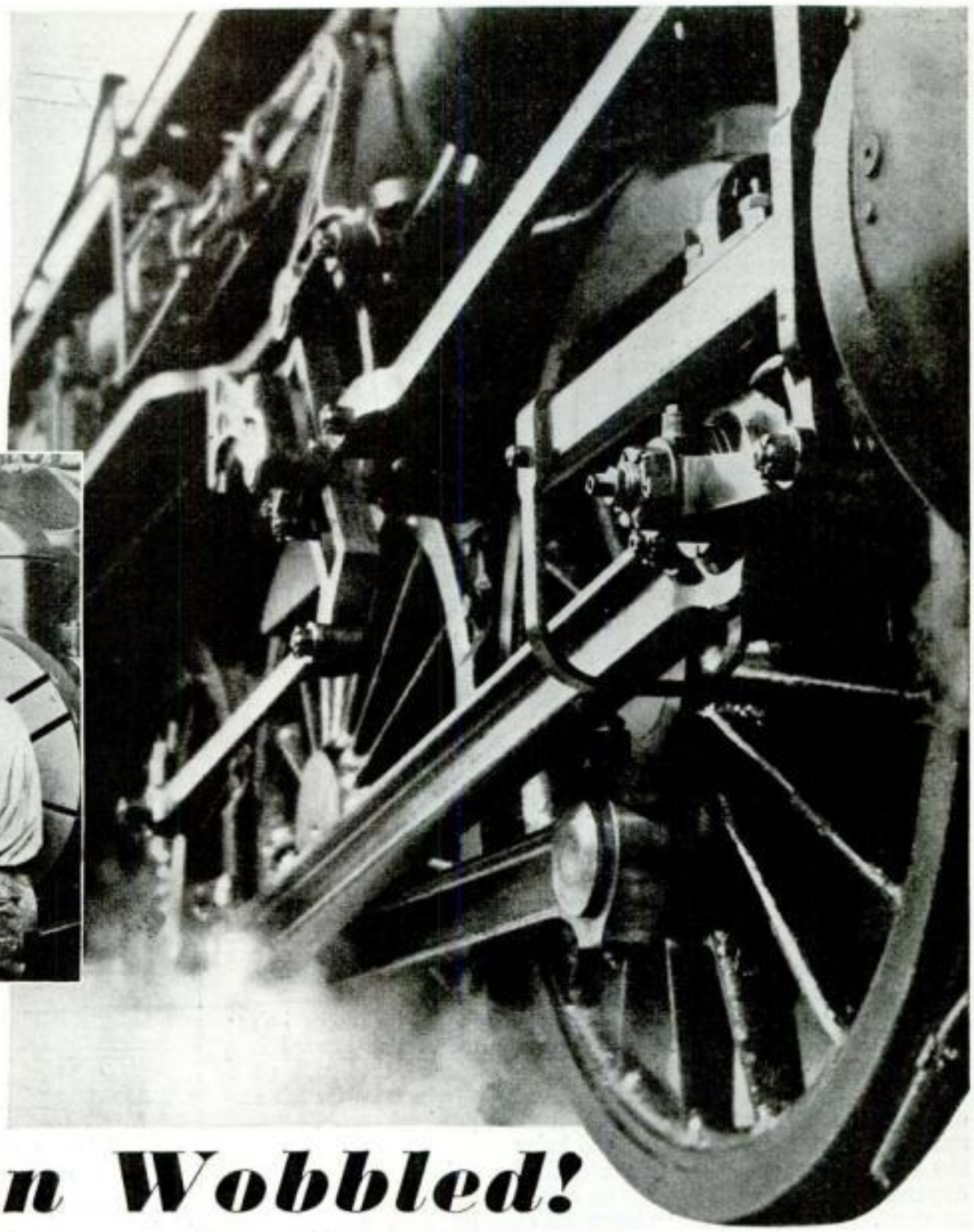
Recutting the top teeth is an easy job. The mill is mounted on an arbor between centers, and the grinding wheel is shaped to the required angle. If the mill is of the plain type, the shape of the tooth may be as shown at *G* and *J* in Fig. 2 of last month's article; if of the high-powered type, the shape is as at *H* in the same illustration, and the method is as shown at *D* and *E*, Fig. 3, of the accompanying drawings. In this case two cuts are taken. When indexing cutters with a finger, it is, of course, necessary that the finger rest on the side of the tooth being recut.

Another expensive item in every shop is the general line of reamers. Those of the solid type become obsolete if slightly undersize, and this happens quickly if they do not cut freely at all times. Indeed, the chief reason why reamers lose their original size before they have seen much service is because the chamfer is not constantly kept sharp. With a dull chamfer, the reamer has to work with unnecessary force, and this evidently causes the periphery to wear itself against the walls of the piece being reamed. The writer believes that if any machine reamer is made to taper .002 in. on its entire length and the corners are kept sharp, it will last three or four times as long as it would otherwise.

Eventually, however, solid reamers become too small and are of no value for their intended sizes. Any reamer may be ground cylindrically from 1/64 to 1/32 in. under its original size without recutting the flutes; on the other hand, any reamer can be reduced as much as ¼ in. in diameter by regrinding it all over.

Take, for example, a 1¼-in. reamer: it can be ground to 1⅛ in. (including the shank) in 45 minutes; and if the reamer has twelve flutes, these may be recut 1/16 in. deeper in the same length of time. The operation is the same as for cutting the top teeth of side mills, a complete flute being finished at each index. Before index-





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This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

ing the next flute, the wheel is dressed slightly, and the flute just finished is touched; this gives it a good finish. The shape of the wheel for salvaging worn reamers is shown at *F*, Fig 3. Reamers thus reclaimed can be compared to new ones, yet they cost about a third as much.

It is not advisable to go into the details of recutting spiral teeth on milling cutters, because in this case, as in a milling operation, the work requires some gearing equipment to generate the desired lead. As stated before, this would never be necessary if the tools were given proper care and attention.

When, however, a shop is equipped with some type of grinding machine for grinding worm threads or the flutes of spiral hobs, a set-up can be arranged for grinding new teeth on spiral mills. The operation is similar to milling. The wheel should be ⅝ in. wide and not much over 3 in. in diameter, and the shape should correspond to that of the double angular milling cutter which would be used if this were a milling operation. In grinding, several cuts are necessary, and of course this requires new adjustments each time so as to keep the face of the teeth radial, whether undercut or not.

Several other salvaging ideas may be mentioned, although these relate to adapting discarded tools to other purposes than those for which they were intended.

Old taps can be made into counterbores of special sizes. It takes about fifteen minutes to grind off the thread and bring the counterbore and pilot to the desired dimensions; then a recess may be cut in as previously outlined and shown at *C*, Fig. 3. Any average counterbore may be made complete in 30 minutes by this method, or at about a fourth of the cost of making it from raw material.

Grind off the teeth of discarded slotting saws to make disk backers and for similar purposes. Old milling cutters of from ½ to 1 in. face make handy plug gages for large holes; all that is needed is a handle that will fit a whole set of such improvised gages.

This is the second and concluding article by Mr. Chamberland on salvaging high-speed tools. The processes of reclaiming damaged shell end mills and broken drills were outlined in the preceding article (P. S. M., May '31, p. 98).

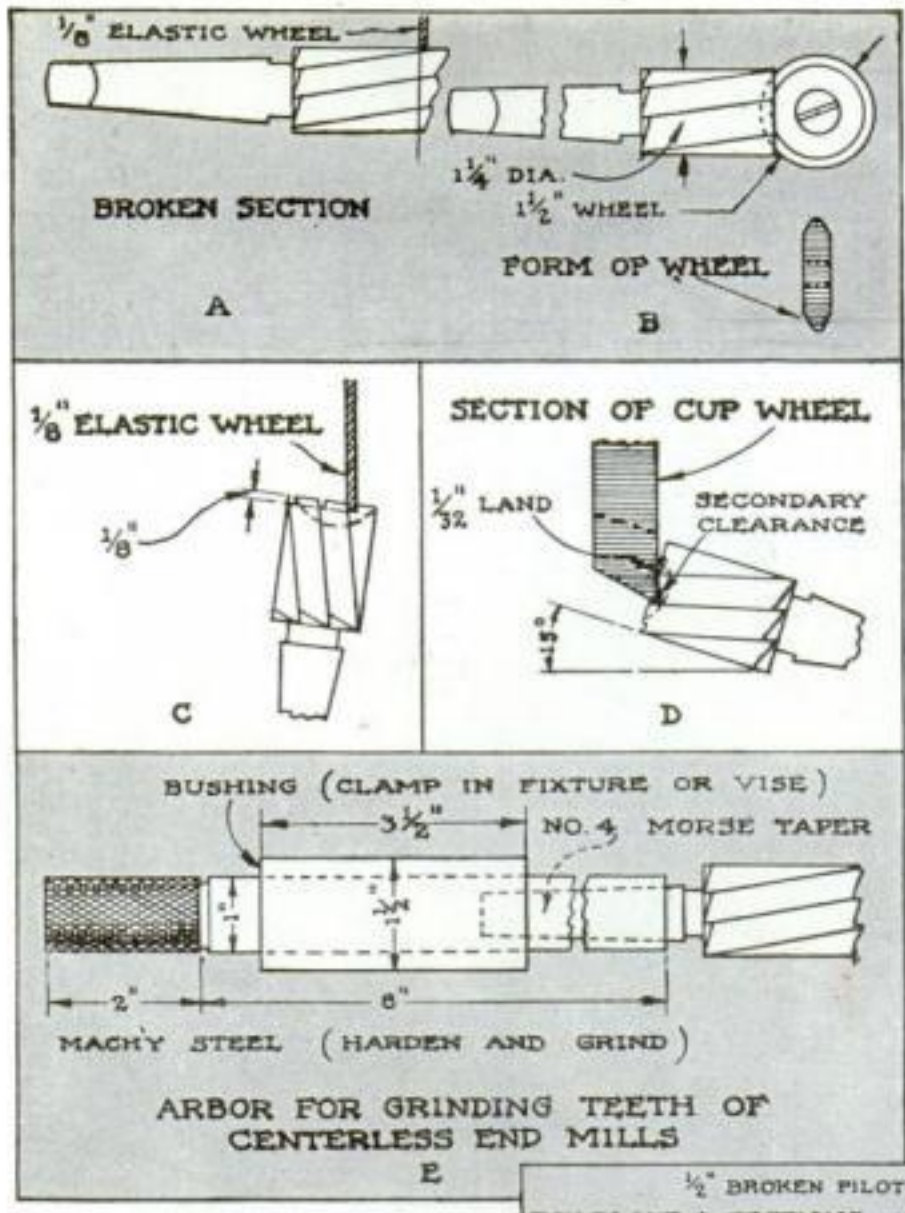


Fig. 2. The steps in reclaiming an end mill (*A* to *D*). The arbor used in grinding peripheral teeth (*E*).

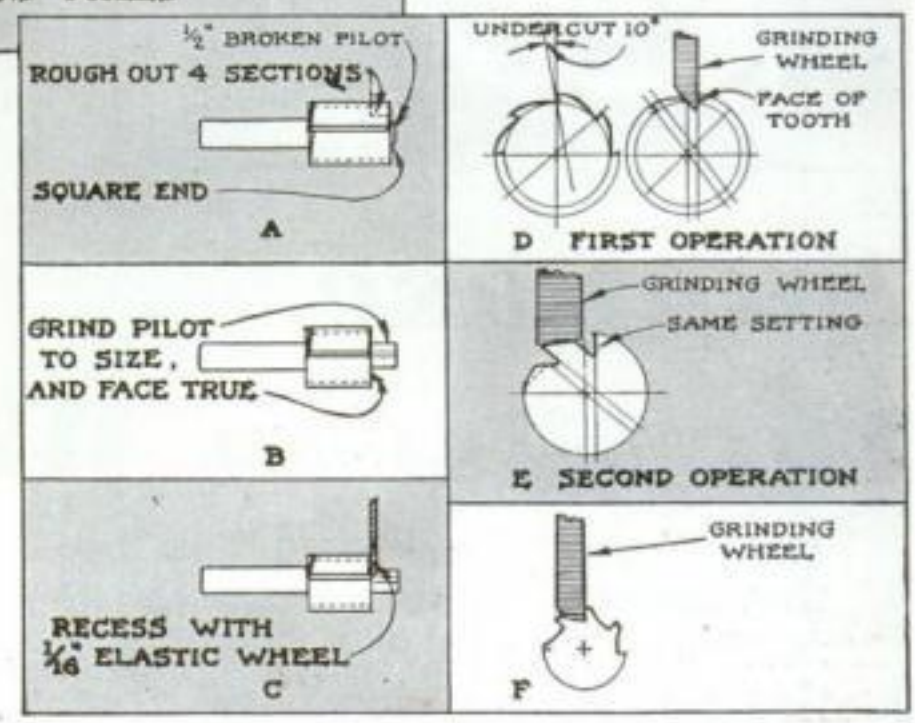


Fig. 3. Repairing a counterbore pilot (*A* to *C*), recutting the top teeth on a side mill (*D* and *E*), and salvaging a reamer (*F*).

Old Bill *Says*—

NEVER straighten tool steel when cold, as it is likely to warp in hardening.

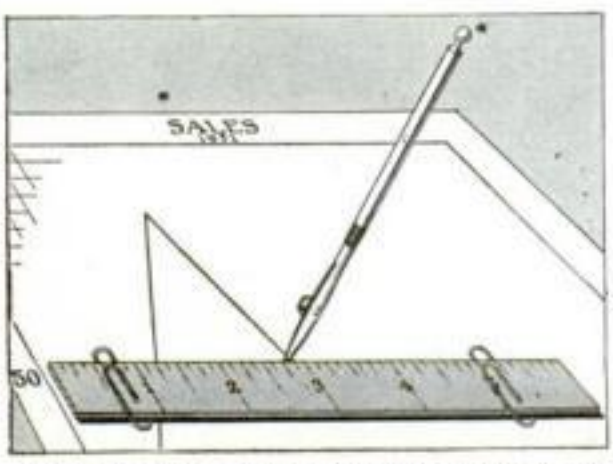
Tungsten carbide tools should be given as much support as

possible, and excessive overhang should be avoided in order to eliminate chatter.

It is much easier to change a design than to use a "putting-on tool" or a melting pot.

CLIPS PREVENT BLOTS WHEN INKING CHARTS

IN MY work I occasionally find it necessary to make certain records in the form of graphic charts. When the finished "curves" on these charts zigzag up and down, there is always the risk of blotting the work. This difficulty led me to make use of the "wrinkle" illustrated. Two wire paper clips are slipped over the ends of an ordinary 6-in. scale. These serve to hold the scale away from the paper, making it possible to draw the lines in ink without fear of making blots or of smearing any of the newly inked-in lines on the graph.—H. S. RUDESILL.



Two paper clips slipped over the ends of a 6-in. scale hold it away from the paper.

HARD steel can be drilled with greater ease and less wear on the drill if the drill point is lubricated with a mixture made up as follows: In about one half pint of alcohol dissolve a few ounces of gum camphor and to this add one half pint of lard oil. With a drilling compound such as this and a very hard drill, plate glass can be drilled, and if a file is lubricated with it, it is even possible to file glass.

STRONG EYEGLASSES AID IN READING "MIKE"

ON A night job recently, I found it necessary to use a micrometer, but, as often happens under such conditions, the light was so poor that it was impossible to take an accurate reading. An older mechanic, who wore very strong magnifying eyeglasses yet could not read the micrometer, suggested that I try his glasses. This I did, and immediately the markings on the micrometer stood out large and clear. Now I always carry a pair of strong magnifying eye glasses in my tool kit and find that they are a valuable addition. Unlike an ordinary small hand magnifying glass, often used by mechanics, eyeglasses allow the free use of both your hands for the manipulation of the micrometer, and this saves considerable time.—WILLIAM A. REEDER.

Simplifying Difficult Measurements

AWKWARD angles, projections, irregular shapes — they appear so often in parts requiring close measurements that they are accepted as commonplace rather than exceptions to the rule.

Oftentimes these difficult measurements are the important dimensions which decide the excellence of the finished work.

Recognizing this problem, the Brown & Sharpe Mfg. Co. has sought continually to perfect reliable precision tools which will simplify the accurate measuring of these irregular pieces.

How well this has been accomplished is best proved by the universal acceptance of Brown & Sharpe Tools wherever the quality of the finished product depends upon a fine standard of accuracy.

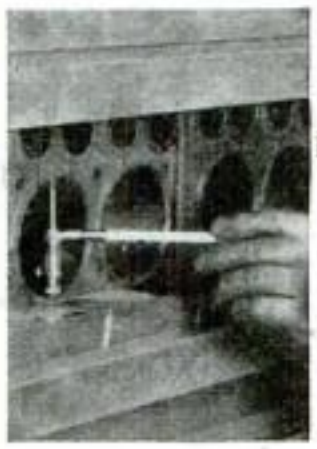
Here are a few of over 2300 popular Brown & Sharpe Tools described in our Small Tool Catalog No. 31. Ask your dealer for a copy or write to us for one. Dept. P. S., Brown & Sharpe Mfg. Co., Providence, R. I., U. S. A.

B·S

Micrometer Caliper No. 12

Range 0 to 1″ by thousandths of an inch

Special shape of frame permits measuring in places inaccessible to ordinary micrometers.



Inside Micrometer No. 264

Range 2″ to 8″ by thousandths of an inch

Clamping device on No. 264 (a distinctive Brown & Sharpe feature) allows the measurement to be preserved.

Handle No. 287 makes it convenient to measure small holes.

Universal Bevel Protractor No. 496
with Acute Angle Attachment

For accurately laying out work and measuring small angles. Supplied with either 6″ or 12″ blades.

Reads to 1/12 of a degree. With acute angle attachment extremely small angles can be easily determined.

Depth Gauge Attachment No. 468

Range 0 to 4½″

Used with a Brown & Sharpe Combination Square, this attachment is useful in measuring the depth of wide recesses.

Tempered Hook Rules No. 320

Seven lengths: 4″, 6″, 9″, 12″, 18″, 24″ and 36″. The sliding hook is a desirable feature. It makes possible accurate measurements against shallow shoulders.

Graduated Rod Depth Gauge No. 614

Range 0 to 3″

Tells the depths of small as well as large holes.

Depths of holes as small as 3/32″ can be easily measured.

Brown & Sharpe Tools

"WORLD'S STANDARD OF ACCURACY"

Ⓢ This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Handling Heavy Castings Safely

Convenient truck for welding outfit—How to make a set of interchangeable cone centers for the lathe

NO KNOWLEDGE of chain hitches, bends, or complicated knots are needed in attaching the safe, positive-acting lifting rig for heavy work illustrated in Figs. 1 and 2. Once the adjustable arms are placed and the weight of the casting is put on the rig, it will not let go until the weight of the work is removed. For the shop where heavy castings are handled, such a rig proves almost indispensable.

The vertical arms are supplied with teeth, making them adjustable in length to take any size casting within reasonable limits. The bottom surfaces of the teeth should be cut horizontal so that they will rest evenly on the upper arms.

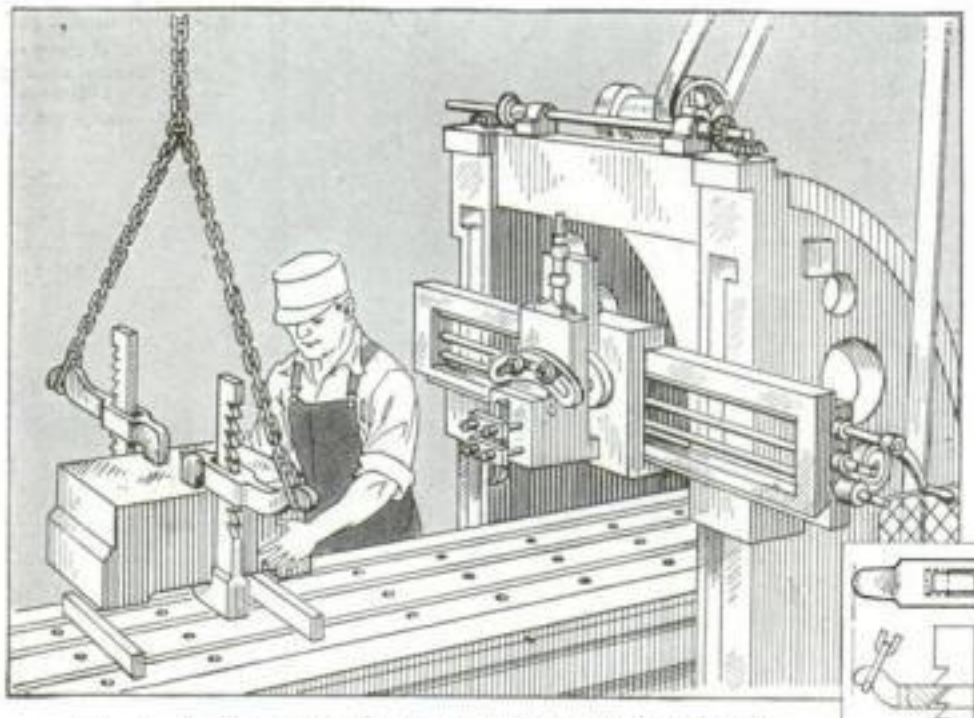


Fig. 1. A foolproof lifting rig that can be readily adjusted to fit any size casting within reasonable limits.

In use, the rig is placed on the casting and then the end link on each of the two lifting chains is hooked over the hooks on each upper arm.—THOMAS MACE.

AN EXCELLENT truck for the shop welding outfit can be made easily from scraps of angle iron, two metal wheels, and an axle retrieved from the shop scrap heap. The entire frame is assembled by welding the various parts together, giving strength and eliminating nuts and bolts which in time tend to loosen.

The cylinder of a discarded automobile tire pump is welded on the rear of the frame and serves to hold the welding rods; and the foot tread on the bottom of the pump is useful in steadying the frame while it is being tipped up prior to moving it (see photograph, Fig. 3).

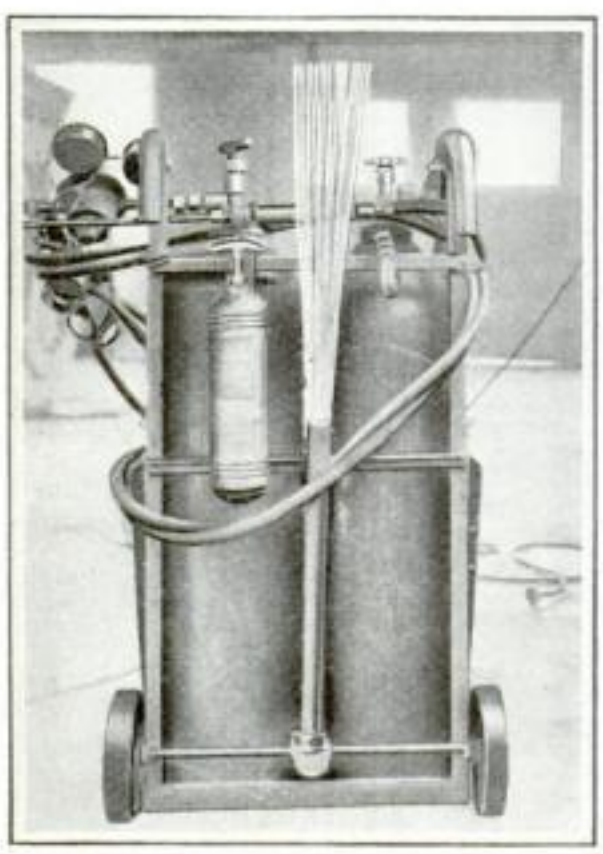


Fig. 3. Rear view of the truck, showing the extinguisher and container for welding rods.

Grips for the ½-in. rod handles can be made by cutting rubber garden hose into sections of the proper length.

An excellent safety measure is the light metal bracket, welded to the rear of the frame, in which a small, hand fire extinguisher can be kept. This will insure having an extinguisher with your portable outfit and not at some distant point in the shop.—JOSEPH C. COYLE.

MACHINISTS who are called upon from time to time to machine pipe, tubing, or hollow cylinders in the lathe will find that a set of interchangeable cone centers such as shown in Fig. 4 forms a valuable addition to their tool crib.

The set of interchangeable centers described is suitable for a lathe having a swing of 8 or 10 in., but the proportions can be readily enlarged to suit a lathe of larger dimensions.

The arbor is turned to the shape shown. The portion *A* should be a Morse taper to fit the lathe; part *B* is 1⅛ in. long and should be a smooth, free-running fit in a ½-in. hole; and part *C* should be tapered to match the end of the drill used in drilling the cones. The end of the arbor should be drilled and tapped to take a No. 10 machine screw.

The set consists of three cones. The two smaller cones are machined from disks finished 1⅝ in. thick and 2¼ and 3⅞ in. in diameter respectively, while the larger one is machined from a 1¾ in. thick, 5⅝ in. diameter disk. These can be finished with flat faces or, if lightness is preferred, with turned out backs as suggested in the accompanying illustration.

Face both sides of each cone and drill a centrally located hole ½ in. in diameter and 1 in. deep to the shoulder. This hole is then continued with a drill just large enough to pass a No. 10 machine screw (see drawings).

Fasten each cone successively to the arbor and turn down the sides to an angle of 30° to the axis, forming a 60° cone. The smaller cone will be .36 in. at the point and 2.24 in. at the base; the second largest will run from 2 in. to 3.87 in.; and the largest from 3.62 in. to 5.60 in. in diameter. A set of cones such as these

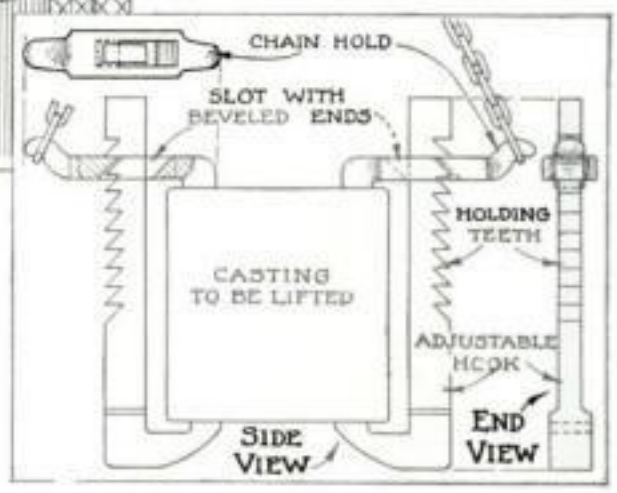


Fig. 2. Four simple forged steel parts make up this ingenious, quick acting lifting rig.

will take work from 5/16 in. to 5½ in. in inside diameter—a range that will take care of all average work.

The arbor is placed in the tailstock and the cone needed for the work in hand is slipped on and fastened. The screw, however, should not be turned up tight, but should allow the cone to turn freely on the arbor.—CHARLES A. PEASE.

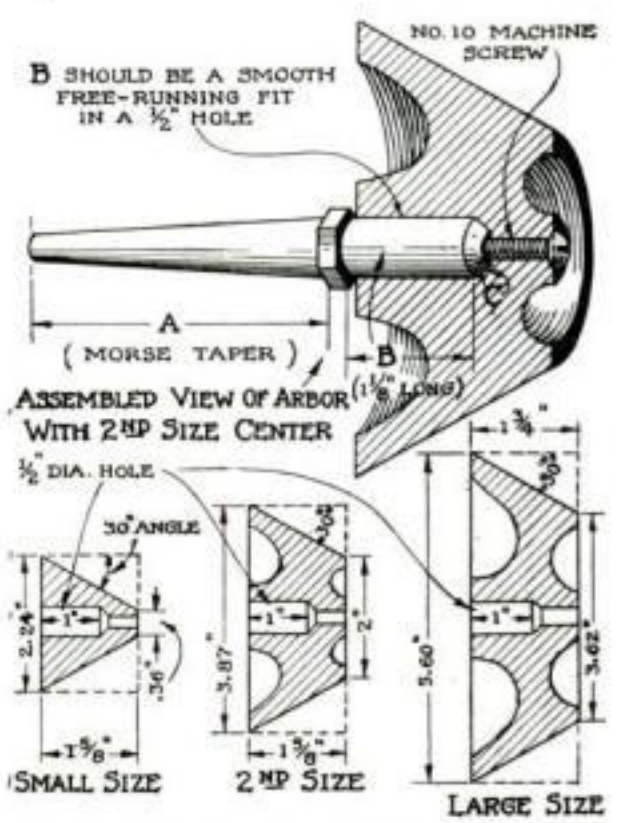


Fig. 4. How the arbor and the three interchangeable cone lathe centers are machined.

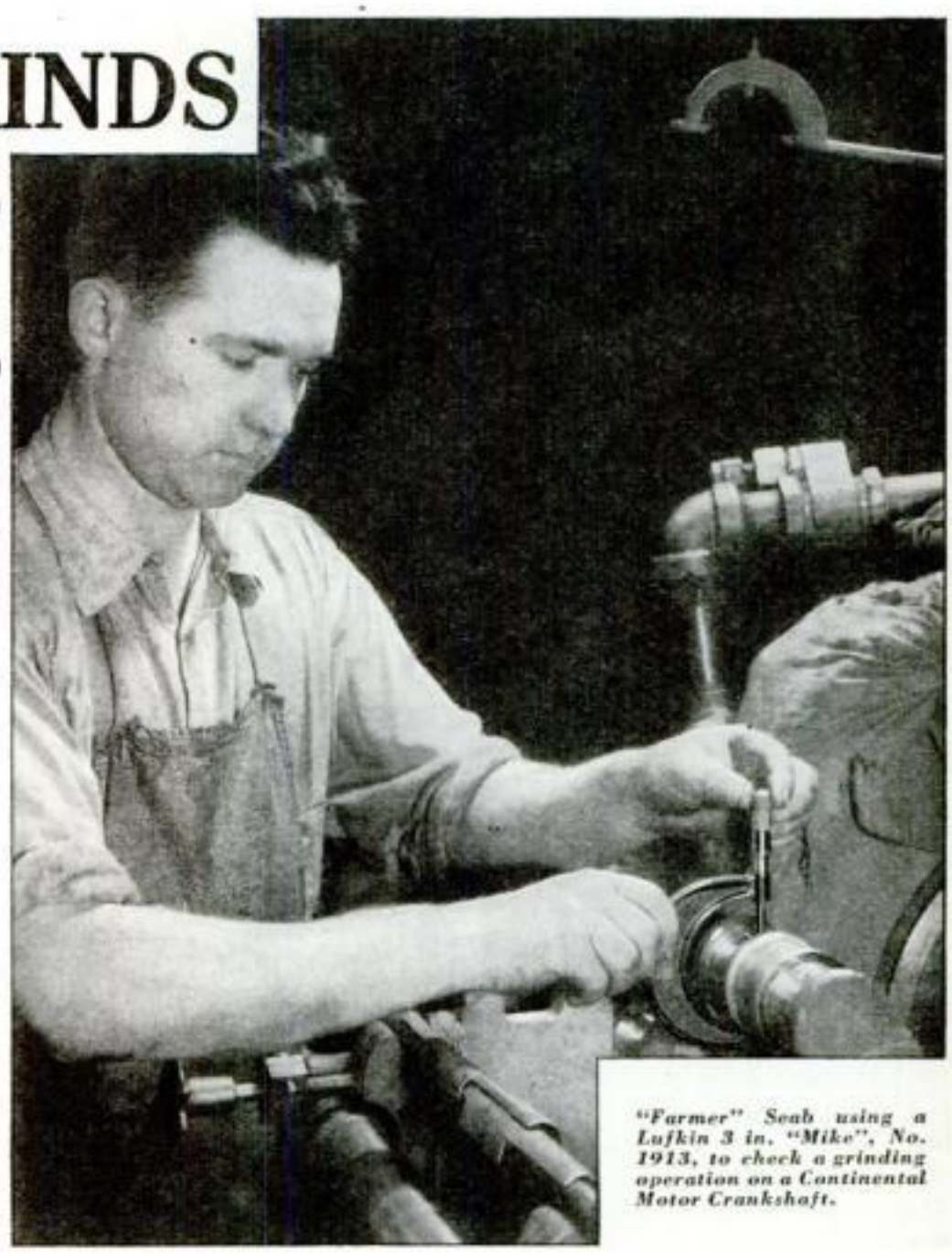
THE "FARMER" GRINDS A BUMPER CROP OF CRANKSHAFTS

AS HE walked through the shop of The Continental Motors Corporation, Joe Nicks, foreman of the Crankshaft Department, pointed out the "Farmer." No one could blame Joe for being proud of his men and his equipment. This shop enjoys as fine a reputation as any in Detroit, and none of them works to closer limits. Their shafts must be accurate to .0005 of an inch in diameter and to within .0003 of an inch of absolute roundness. "If not," said Joe, "the motor will run noisy, get hot and develop a wheeze." And he added, "Grinding and inspecting crankshaft pins is another precise job: even with our facilities and highly skilled machinists we turn out, on an average, but six crankshafts an hour."

We stepped over to the grinder where "Farmer" Seab was checking his work, as pictured on the right. Eleven years ago Lamar Seab—now known in the shop as "Farmer"—started in the Crankshaft Department as a helper. Now he is a skilled mechanic. In these years he has certainly learned a lot about crankshafts and the precision tools that make them possible.

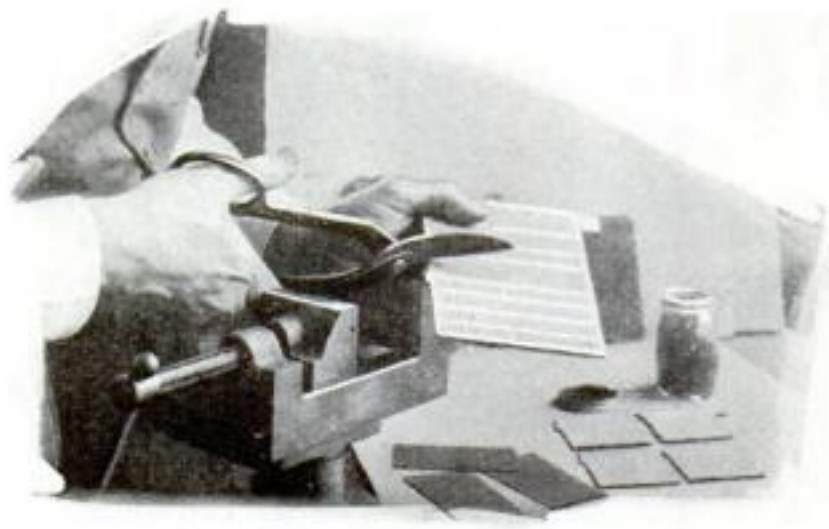
"When I go to the tool crib," said "Farmer" Seab, "I ask for the Lufkin 3" Micrometer, No. 1913. It's easy to read and it's accurate. With it I can work fast and not worry about mistakes. It's sturdy, but not too heavy—it's designed for production work and it fills the bill."

Thousands of skilled mechanics are of the same opinion. They appreciate the large and deeply cut numbers, the numbering of each thousandth, the ease of accurate adjustment, and the other features that have made Lufkin "Mikes" so popular.



"Farmer" Seab using a Lufkin 3 in. "Mike", No. 1913, to check a grinding operation on a Continental Motor Crankshaft.

A New and Easy Way to Make Small Storage Batteries



Tiny cells, incased in celluloid, provide efficient source of power for ship models

By MARK A. COOPER

THE hundreds of readers who are building working models of the destroyer *Preston* from our blueprints (see page 117) and everyone interested in electrically driven ship models will appreciate the advantages of being able to build their own small storage batteries. It provides a good way to solve the model power-plant problem.

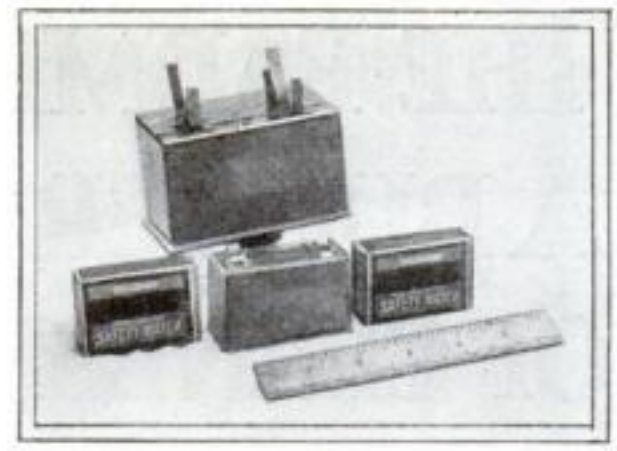
SMALL storage batteries for use in ship models or for experimental purposes can be made without difficulty to suit any space available. It is necessary merely to have the plates ⅝ in. lower than the maximum height of the space into which the battery is to fit, and ½ in. narrower than the maximum available width.

For charging such small batteries, trickle chargers designed for radio batteries are ideal, and these are frequently obtainable for little or nothing.

The list of materials is as follows: 1 piece of automobile curtain celluloid, about 8 by 18 in., and some small scraps of the same celluloid; 2 oz. of acetone; 1 new positive plate and 2 negative plates for an automobile storage battery; 2 separators (keep these in water until used); 1 piece of sheet lead, 1 by 6 in. and approximately 1/16 in. thick. These materials will make a 6-volt battery with three cells, the plates being one fourth the size of the regular automobile battery plates. There are two negative plates and one positive plate in each individual cell.

Dissolve enough celluloid scraps in acetone to make about an ounce of cement solution, slightly thicker than water.

Put the positive plate between the two negatives, with separators between the plates, and measure carefully the total thickness (see the drawing marked *A*). Add 1/16 in. to this to get the thickness of the boards used when spacing the cell partitions. (This dimension is hereafter referred to as *T*.) Also measure the distance between the insides of the negative plates, indicated hereafter as *K*. File a piece of iron or steel 2 in. long to this thickness. Later, the negative plates can be clamped on either side of this while burning them together.



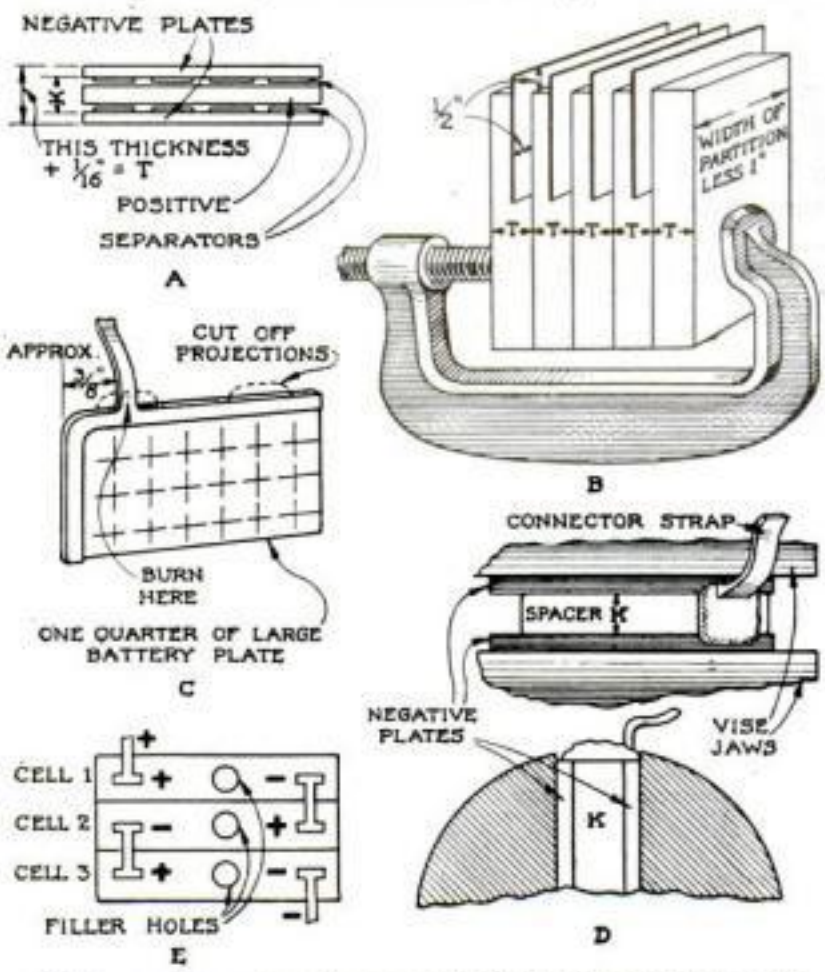
Two tiny storage batteries, one being little larger than the match boxes which flank it.

With tin snips, cut the plates down the center, both top to bottom and side to side, making four small plates from each large one. Divide the separators similarly. Then cut from celluloid the four cell partitions, ¼ in. longer and ¼ in. broader than the plates.

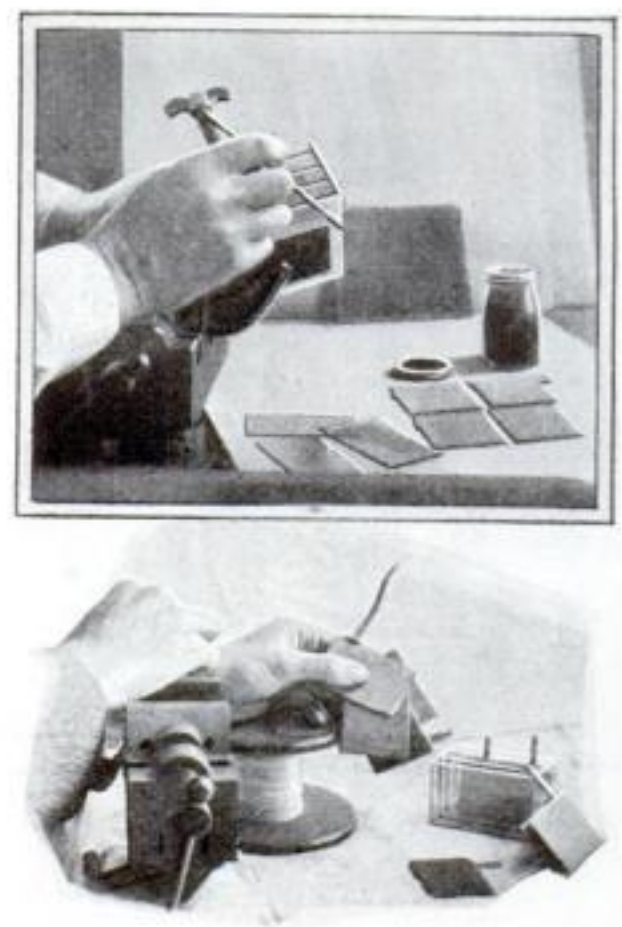
Make five spacer boards 5 in. long, their thickness being *T* and their width equal to the length of the celluloid partitions less 1 in. Clamp the four cell partitions between the spacer boards, as shown at *B*. Let ½ in. of celluloid show at either side and at the end. True up carefully, so that the ends and bottom of the finished cell case will be square.

Cut a piece for the bottom large enough to project ⅛ in. all around, and, using a very small water color brush, cement it in place. Keep the cement thin and go over each joint again and again very lightly, blowing on each coat. Reach in between the cell partitions with the brush and gradually build up a fillet in the bottom corners.

Next cut out the celluloid ends; these should rest on the bottom and against the cell partitions and should project ⅛ in. at sides and top. Cement them in



Plates and separators for one cell *(A)*; clamping the celluloid partitions *(B)*; how connections are made *(C, D,* and *E)*.



Upper view: Cementing the outside joints of the celluloid case. *Lower:* The cell units.

WORLD'S LARGEST WELDED ROOF FOR WINDOWLESS PLANT

Color Authorities Designing Interior Color Scheme

Like many of the other innovations in industrial construction which are being employed for the first time in the Simonds "Controlled Conditions" plant, now being built at Fitchburg, Mass., the roof has been designed and built by well known engineering authorities assisted by experts on insulation and noise-proofing. The entire roof, which contains over 200,000 square feet, is supported by a welded structural steel frame, made necessary to some extent by the desire to reduce the number of interior columns to a minimum.

A special noise insulating material (a wood product) is laid in layers with a waterproofing compound in such a way that the roof kills noise and vibration instead of acting as a giant sounding board. At the same time it insulates the interior of the plant against heat and cold from without.

The nation's foremost color authorities have been consulted in an effort to obtain for the interior of the Simonds plant the exact colors to promote ideal working conditions. It is a recognized fact that certain colors help keep workers in a cheerful frame of mind.

Machinery in the Simonds plant, for instance, will be painted orange-yellow to increase visibility and thereby aid in accident prevention.

A special column writer for a leading daily paper wrote this limerick when he read about the new windowless factory now being built for the Simonds Saw and Steel Company:

"In short, regardless of the sun
That plant will not depend upon
Outside illumination.
And so it's very plain to see
That making Simonds Saws
Will be a paneless operation."

Another man offers this:—

"In Simonds brand-new factory,
In which their saws are made
That shine so bright, need no sunlight,
They make them in the shade.

"Of course, we'll all be sending
Our orders for this tool.
Long years they've stood—they've been so good
Satisfaction is the rule."

Could you write a jingle about this amazing new plant? It's easy. Send in your contributions—they'll be welcome.

place just as you did the bottom piece.

When the cement is dry, test each cell with water. Stop any leaks with several coats of cement. This finishes the cell case.

Take two negative plates; cut off any projections on the original outer rim, and turn up the latter as shown at *C*. Insert the iron spacer *K* and put all three in the vise as at *D*. Bring the top of the plates and spacer *K* level, but keep them about 1/16 in. below the top of the vise jaws.

Cut the sheet lead into 1/4 by 6 in. strips. Then lead burn the plates together, and burn on a 1/4-in. connecting strip as shown at *D*. It is also necessary to burn a connecting strip on each positive plate near the end, as shown at *C*. For those who are not equipped to do lead burning, the best plan is to take the plates and the spacer *K* to a battery service station and have the job done there. It should not take more than fifteen minutes. A small oxy-acetylene lead burning torch is necessary to produce an autogenous lead weld, which is really what lead burning is. Soldering is uncertain; sometimes it works and sometimes it does not.

SLIP the separators and the positive plates between the three pairs of negative plates, with the positive connector opposite the negative one. This gives three sets of plate assemblies, with the negative connector at one end and the positive connector at the other. Put these in the cell case so that positive and negative connectors of adjacent cells will be together, as shown at *E*.

Remove the plate assembly from the center cell. Cut out celluloid tops for the two outside cells and punch a 1/4-in. filler hole in the center of each, as well as holes for the terminals. A close fit is not necessary for the latter. Fit the cover tight at the ends and let it project over the outside partition 1/8 in. It should be flush with the inside partition of each outside cell.

Cement each top to the inside partition first. Make sure there are no leaks here, because you cannot get at this joint again. Then cement well at ends and on outside.

REPLACE the plates in the center cell, making sure that positive and negative connectors are at the correct ends (see *E*). Cut the top for the center cell to fit close at ends and to lap over 1/8 in. on the outside cell tops at the side; then cement it well.

Cover up any openings around the connectors with tiny scraps of celluloid, well cemented down. Build up a generous extra thickness here.

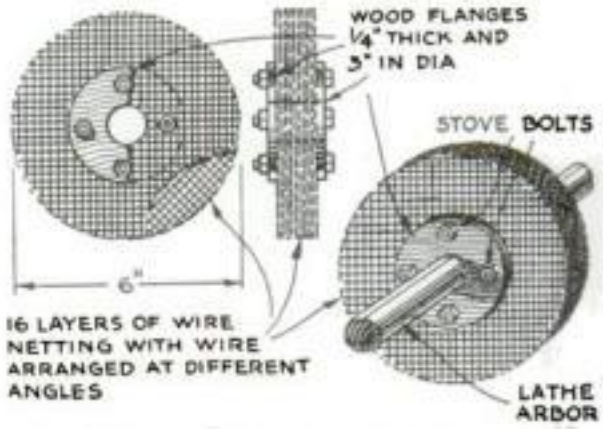
Cut off the connectors so they just touch when bent together, and solder them as at *E*. These connectors should, when soldered, form an arch about 1/4 in. above the celluloid cell top; the heat of the soldering iron then will not damage the celluloid. Leave the main positive and negative terminals 2 in. long. Coat the connectors well with cement to avoid corrosion, and paint the main positive terminal red.

Fill the cells with dilute sulphuric acid. For the plates used by the writer, a 13.40 hydrometer reading is required. Ask the service station the proper reading for the plates you have used. Let the battery stand for twenty-four hours, adding extra solution as the plates soak it up. The acid should never be below the top of the plates.

Charge at 1/2 ampere for twenty-four hours or longer. The battery can be tested for full charge at a service station; but if, when the terminals are shorted, a loud, popping spark is heard, it is probably sufficiently charged for use. While 1/2 ampere is correct for the original charge, four of these small batteries have been recharged at a 2-ampere rate without any apparent damage. Distilled water should be used in filling the batteries from time to time.

Obviously, these batteries will not stand rough handling. Care should be taken to place them in a model in such a way that they will not be jarred or crushed. They might be protected in a case made of rubber from an old inner tube, if the builder believes it advisable. Another precaution—although the author did not find it necessary—would be to place spacers beneath the plates to raise them a trifle from the bottom; this would reduce the danger of the plates' being short-circuited by the sediment.

WIRE SCREENING USED FOR BUFFING WHEEL



A quickly and cheaply made wire scratch wheel formed from disks of wire screening.

SOME time ago while doing a rush job, I found that I was in immediate need of a wire buffing wheel or scratch brush. Not having the time to go out and purchase the type of buffer I wanted, I worked out the idea illustrated above.

From some old wire screening I cut sixteen 6 in. diameter circles. These I placed one on top of the other in such a way that the wires in the screening did not run in the same direction. Then, with the aid of a coping saw, I cut two 3-in. disks from a piece of 1/4-in. box wood. These I clamped on each side of the wire screening with four stove bolts.

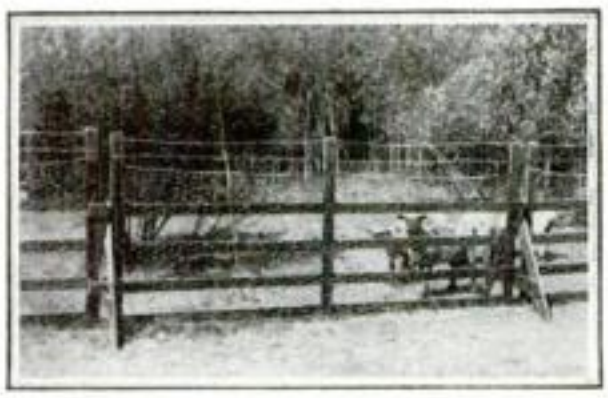
To set up the buffer, I drilled a hole in the center and then mounted it on the lathe arbor.—JULES J. SIEKMAN.

A SHEET of sandpaper is excellent material from which to make a pattern for marking sheet metal, especially where the work is not longer than 10 or 12 in. Place the pattern with the sanded side downward so that the gritty surface will keep it from slipping. A sandpaper pattern is also advantageous for fabrics with a glossy finish.—EDMOND E. LEMASTER.

STRONG PORTABLE FENCE BUILT IN SECTIONS

THIS fence, although easily portable, is surprisingly strong and firm. Built entirely of 1 by 4 in. lumber, it is made in sections 10 ft. long. The horizontal boards are placed 12 in. on centers, and the uprights are 5 ft. high.

Every other section has three boards arranged in a sort of "A" shape at each end, as shown; otherwise all the sections are exactly alike. The top board and the

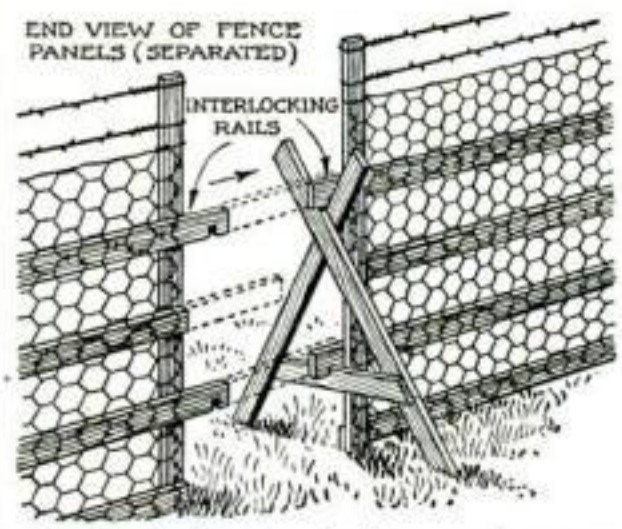


Even though easily portable, this sectional 5 ft. high wire fence is extremely sturdy.

second one from the bottom extend about 6 in. beyond the uprights at each end, and a notch is cut into each of these projecting ends about 1 in. wide and 1½ in. deep. The notch in the lower board is so placed that it will fit on the crossbar near the bottom of the "A" frame of the adjacent section; and the upper notch fits into the "V" at the top of the "A."

Each section is covered to a height of 4 ft. with 2-in. mesh chicken wire, and as an added protection, two lines of barbed wire are run at the top. The wire is nailed to each section independently.

When one desires to move this fence, it is necessary only to lift each intermediate unit slightly—just enough to free the interlocked ends from the "A" supports—and the sections then can be carried away one at a time and erected just as easily in a new location.—HARRY A. KAY.



Detail showing how the fence sections are interlocked over the intermediate "A" frames.

AN INEXPENSIVE holder for phonograph records is an "accordion" letter file, obtainable at any stationery store for fifty cents. Such files will hold more than twenty 10-in. records, nearly twice the number accommodated by the commercial record books. Besides protecting the disks from dust and breakage, the file makes them readily accessible, since the name of the record in each compartment can be written at the top of its envelope.—E. W. T.

Caring for Your Electric Motors

By HAROLD P. STRAND

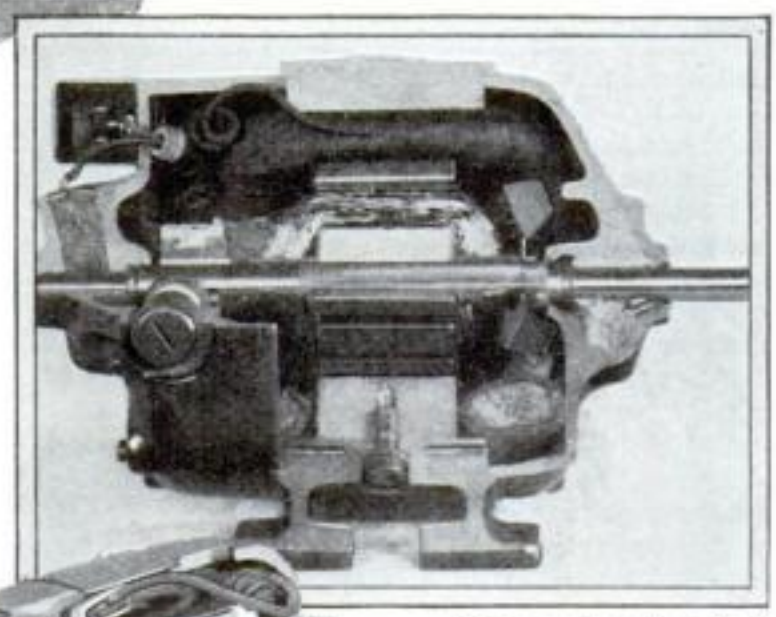
Lubrication is an important consideration in the care of motors.

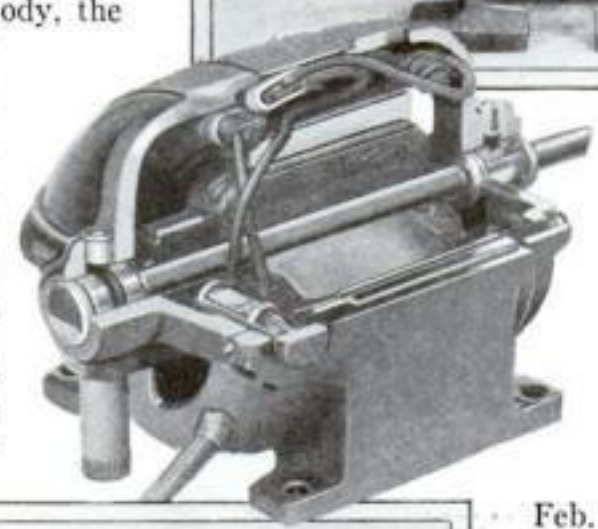
A CHAIN is as strong as its weakest link, and a home workshop is as efficient as its motive power. We may have the finest of tools, the best in machines, and the ability to turn out excellent work, but if our motors are worn and fail to supply the rated power, our home workshop machinery will probably bring us more grief than pleasure.

Like the human body, the electric motor usually indicates trouble by an excessive increase in temperature. It so happens, however, that most motors are designed to run at full load with a rise of some 104° F. above a room temperature which is taken as being maximum at about 100° F. This brings the danger temperature somewhere near that of boiling water, a temperature that is difficult to judge by the touch of the hand or by any method other than using a thermometer. Thus, with no way of determining accurately just when a motor is overheating, the care of the motor, as far as the amateur is concerned, should be one of periodic inspections with the idea of preventing trouble rather than curing it.

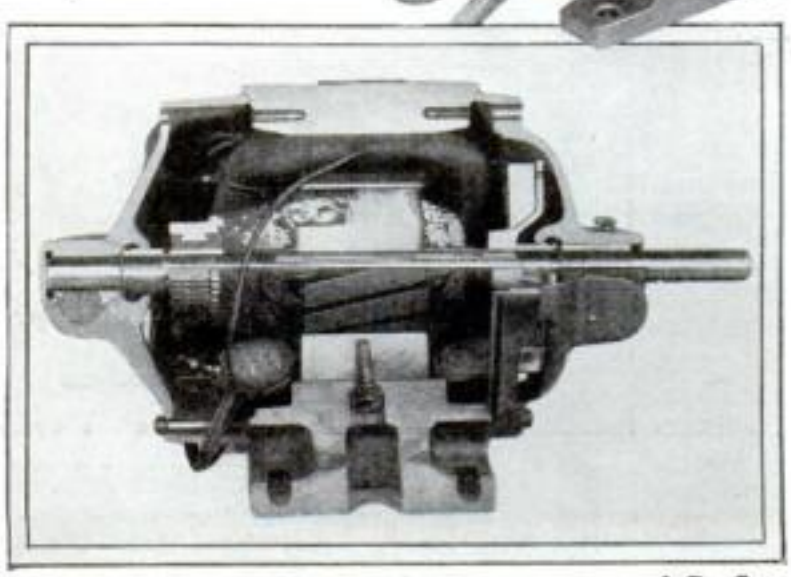
Motors having brushes and a commutator perhaps require a little more care than others, since it is necessary to keep the commutator clean and the brush contacts in shape in order to insure perfect electrical contact. A small piece of fine sandpaper held against the moving commutator with the hand, or better still with a piece of softwood, will effectively clean it. (See P. S. M., Feb. '31, p. 108.) Never allow the brushes to wear down too short, and be sure that the spring which forces each brush against the commutator supplies the necessary pressure.

If you have the type of split phase motor that employs brass rings and brushes to carry the current to the rotor, be sure that these rings are clean and that the brushes make contact. If you have the more general type of split phase motor, which employs a centrifugal clutch that throws the start-





Above: A sectionalized D. C. motor. *At left:* A universal motor for A. C. or D. C. current.



Cutaway view showing another common type of D. C. motor. Notice wool-packed bearings and oil return holes.

ing winding out of the circuit when the motor has reached the correct speed, be sure that the parts work freely and that the points of contact are clean (see photograph top of page 114).

Overheating may be the result of any one of a number of motor troubles, but most difficulties along this line can be prevented by a periodic inspection of the lubrication and bearings, and by avoiding overloading and tight belts.

Keep the oil wells filled to the required level with a good grade of medium light machine oil. If the wells become clogged and gummy, drain the oil, wash the wells out with kerosene or gasoline, and refill them with fresh oil.

IF the motor is supplied with grease cups, be sure that they are filled and that the wicks that carry the lubricant to the bearings are doing their work.

Test your motor at frequent intervals for worn bearings. This is especially necessary if the motor is old. Grasp the shaft of the motor in the hands and test for up-and-down play. End play, to a certain extent, may be ignored, since all motors are constructed to give the shaft some lengthwise freedom.

Drive belts on motors should be kept only tight enough to supply power for the greatest load that will be required. This load, of course, should be well within the limit of the rated power. A tight belt not only will cause the motor bearings to wear but it will also make the motor labor.

The problem of not overloading the motor, of course, is one of common sense judgment. A small circuit breaker for use on small motors is now available. With a device such as this used as a switch, it will be impossible to overload the motor.

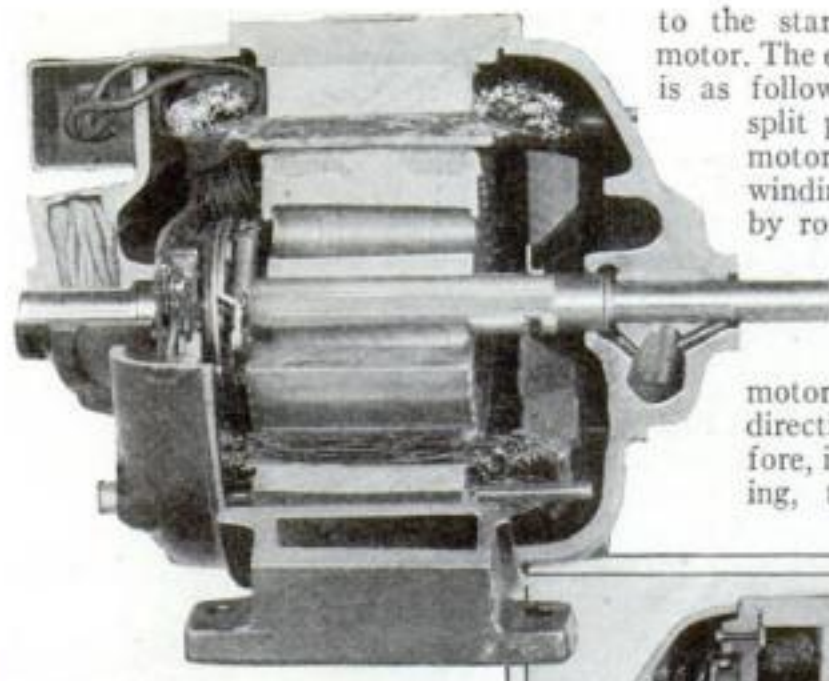
If you are at all in doubt as to the rated horsepower of the motor, be sure to find out from the manufacturer.

ONE cause for overheating which cannot always be prevented but which can be detected is that of a short or open circuit. The coils in either the field or rotor windings, when tested with a magneto or test lamp, should be continuous, and no circuit should be found between any commutator segment and the shaft; and there should be no connection between any coil and the motor frame.

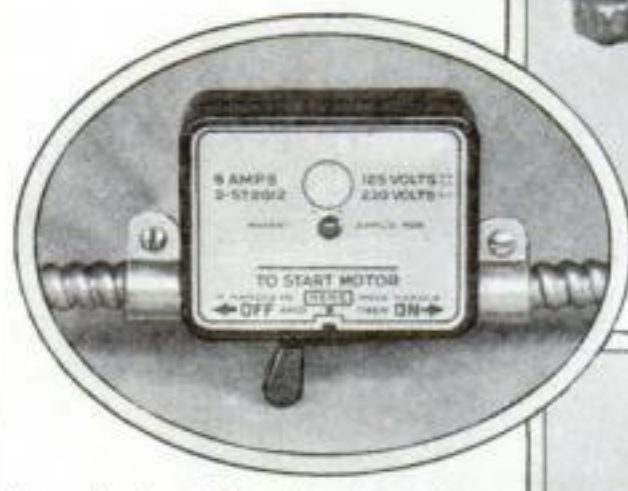
To determine whether a motor is designed to operate on alternating or direct current, first look at the name plate; if you see the word "PHASE" it is an alternating current motor. This is also true if the words "REPULSION-INDUCTION" appear on the plate. On the other hand, the words "SHUNT," "COMPOUND," and "SERIES" are indicative of motors designed for direct current use.

It is often found necessary when placing a motor in a shop to reverse its direction of rotation. The simplest of all motors to reverse is the multiphase type on which it is necessary only to reverse any two leads in the motor circuit. This type of motor, however, is more common in industrial plants where three-phase power is available. The home seldom has anything but single-phase current.

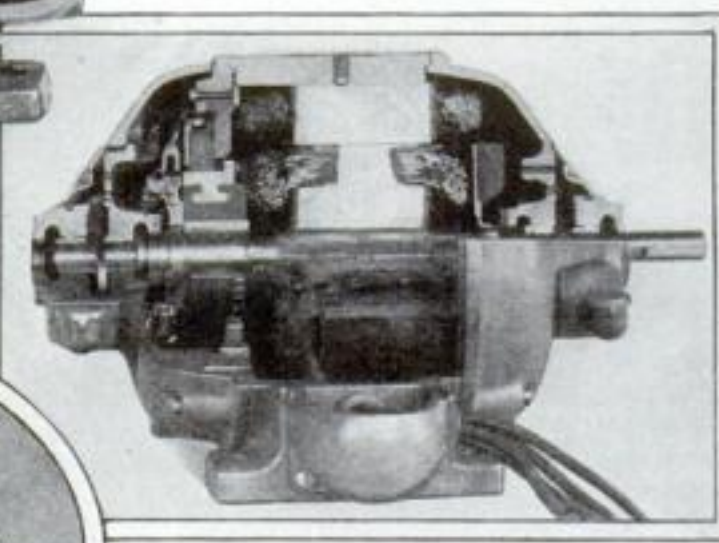
The "rotating field" type of motor has



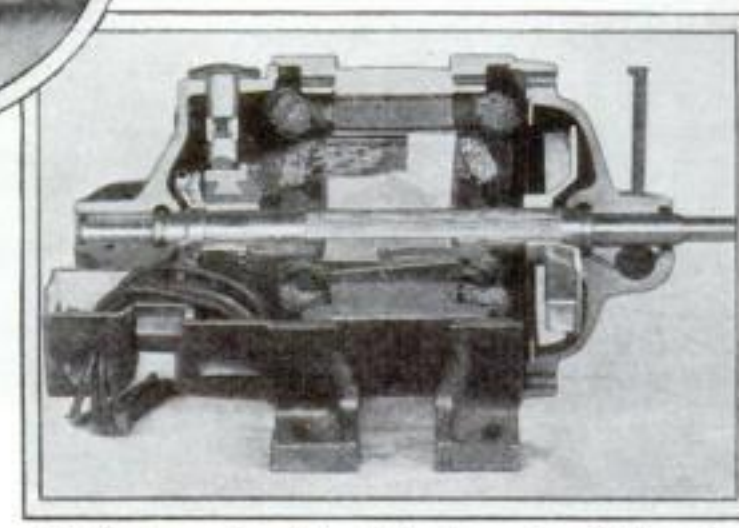
One type of split phase (A. C.) motor. The starting clutch can be seen at left of the armature.



A small circuit breaker that will prevent the overloading of motors.



A repulsion-induction motor. Note the short-circuiting ring just at right of armature.



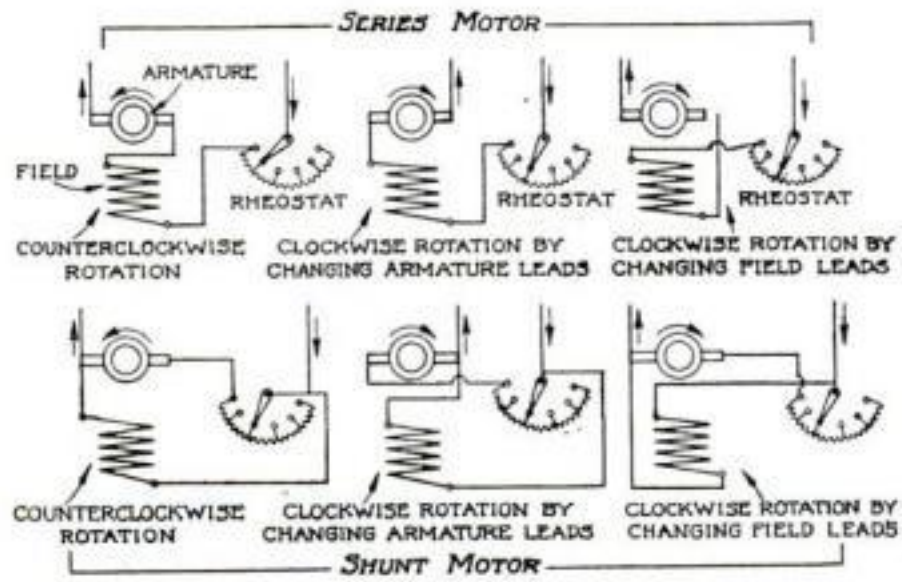
Another type of repulsion-induction motor. This particular motor was designed for long uninterrupted service.

four terminals on the edge of the outer brass rotor ring, three of which are grouped together. By interchanging the two wires connected to the two top screws the direction will be reversed. Or, to put it differently, interchange the leads going to Nos. 1 and 2, counting the terminals down from the top. To reach these screws it will be necessary to remove the end shield on the motor by loosening a few screws.

If the split phase motor that you have is not equipped with these four terminals, it will still have the four leads and it is necessary only to reverse the two leads to the starting winding to reverse the motor. The explanation back of this change is as follows: If we were to take any split phase motor or any induction motor and disconnect the starting winding, we could start the motor by rotating the rotor by some outside means in either direction until it had reached the required R. P. M. When this speed is reached, the motor will continue to rotate in this direction without outside aid. Therefore, if we reverse the starting winding, the motor will run in the reverse direction in starting and will continue to revolve in this direction when the starting winding is thrown out of the circuit.

Repulsion-induction type motors are easily reversed; ordinarily it is only necessary to shift the brush ring around to a different indicating mark.

Several methods for reversing D. C. motors are illustrated in the simplified wiring diagrams shown at the left. On small home workshop motors, of course, rheostats will not be wired in the circuit as shown.



Diagrams showing how D. C. motors can be reversed by changing the leads. Of course, rheostats are omitted on smaller motors.

This article supplements one on lighting home shops (P.S.M., Sept. '30, p. 98) and another on wiring a shop for light machinery (Oct. '30, p. 116).

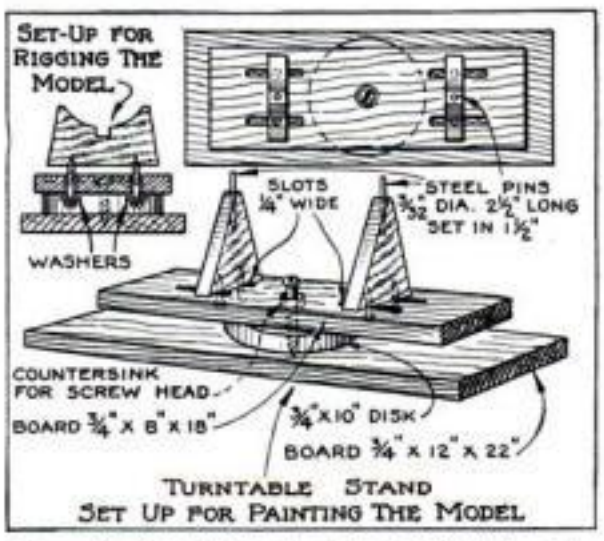
ROTATING STAND AIDS IN CONSTRUCTING SHIP MODELS

Pin supports hold the model while it is being painted.

THE turntable stand illustrated will be found helpful in painting a ship model, especially as it holds the hull so that the entire bottom can be painted without interference. When the painting has been done, the pin supports are replaced with regular cradles, which hold the model steady while it is being rigged.

The slots in the base allow the uprights to be adjusted to suit models of various sizes. The stand need not, of course, be built exactly the size suggested, but in changing the dimensions the proportions should be adhered to closely. In no case should the wood be less than ½ in. thick or the pin supports less than 7 in. high.

The slots in the base are formed by boring ¼-in. holes the proper distance apart, depending on the size of the stand being constructed, and sawing or chiseling out the intervening wood.—T. J. HAND.

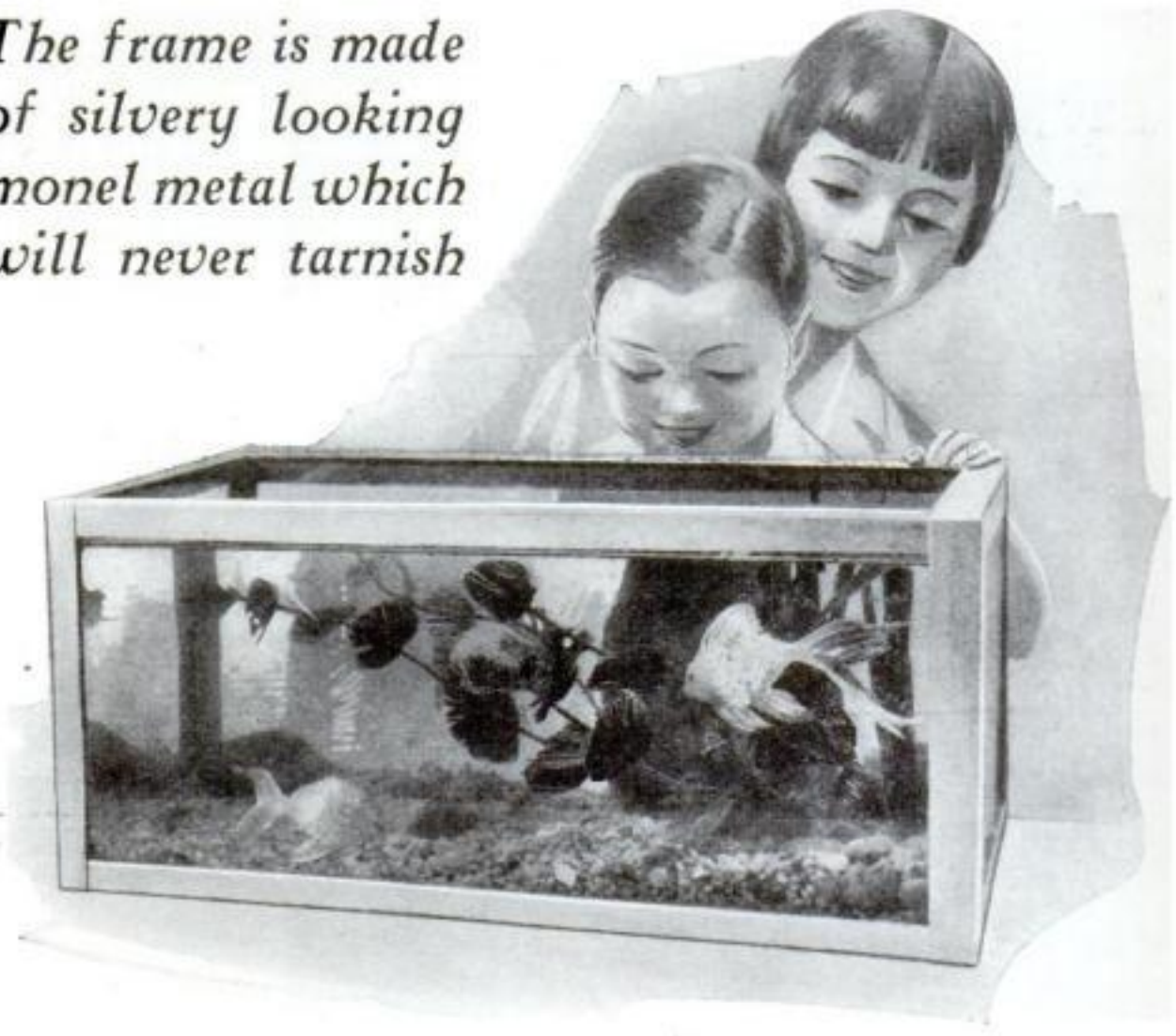


How the turntable stand is constructed, and the set-ups for either painting or rigging.

HAVE you ever wished to drill a hole in a place where there was not enough room to turn the brace? The next time you do, remove the bib cock from the kitchen faucet and fasten it over the end of the bit. Little room is required to turn the handle, and if space is at a particular premium the bib cock can be removed each half turn and replaced in a position where it will not strike for another half turn.—M. E. CRUMB.

A Unique New Aquarium

The frame is made of silvery looking monel metal which will never tarnish



By EDWARD THATCHER

NOT often will you see a goldfish aquarium with a silvery framework of that new and modish material, monel metal, yet there are few more attractive decorations for the home. The metal is brilliant in appearance, does not tarnish, and is easy to work. If, however, it cannot be conveniently obtained, copper or brass may be used in exactly the same way.

The glass for the aquarium illustrated above came from broken automobile windshields. If plate glass cannot be obtained from this source, thick window glass will be quite satisfactory.

Naturally, a much larger aquarium may be constructed by the same methods, and it can be made six- or eight-sided, if you like. Bear in mind, however, that a good aquarium should be wider across the top than it is high.

Strips of No. 24 gage monel metal 1½ in. wide are heavy enough if folded at a right angle for their entire length. While they can be bent with the fingers, they are very rigid in the finished framework. If heavier metal is used, say No. 18 or 20 gage, it is better to take the strips to the tinner's and have them folded in a heavy cornice brake. You can avoid the work of folding the strips, however, if you are able to purchase ⅜- or ½-in. monel metal or brass angle stock. Very large aquariums can be made of common angle iron, riveted or bolted together.

If monel metal is used, the pieces should be polished before the frame is assembled. Copper or brass must be painted or lacquered when completely assembled. *(Continued on page 118)*

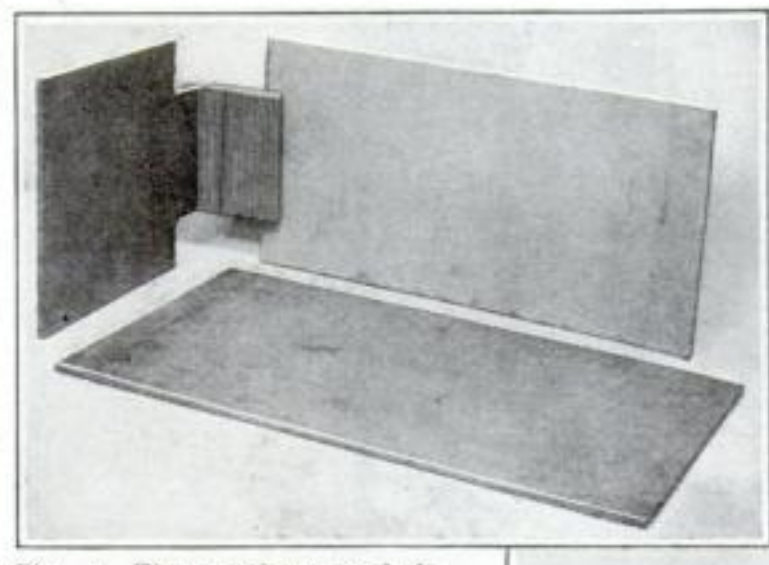


Fig. 1. The templates used in soldering. Note how the side and end templates are notched and held together by a block of wood.

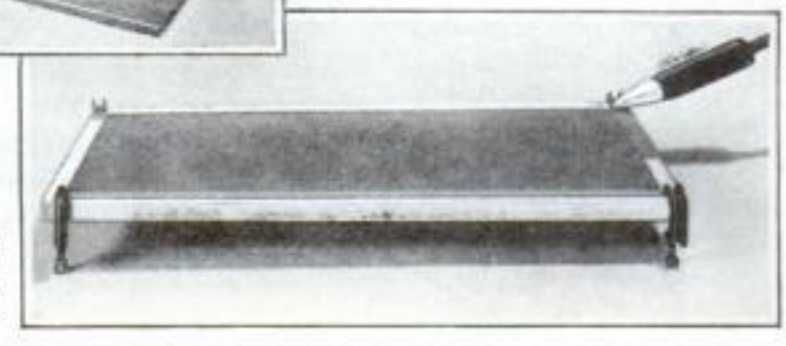


Fig. 2. How the pieces for the top frame are clamped over the templates and soldered. The bottom is made in exactly the same way.

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TO ASSIST you in your home workshop, POPULAR SCIENCE MONTHLY offers large blueprints containing working drawings of a number of well-tested projects. Each subject can be obtained for 25 cents with the exception of certain designs that require two or three sheets of blueprints and are accordingly 50 or 75 cents as noted below. The blueprints are each 15 by 22 in.

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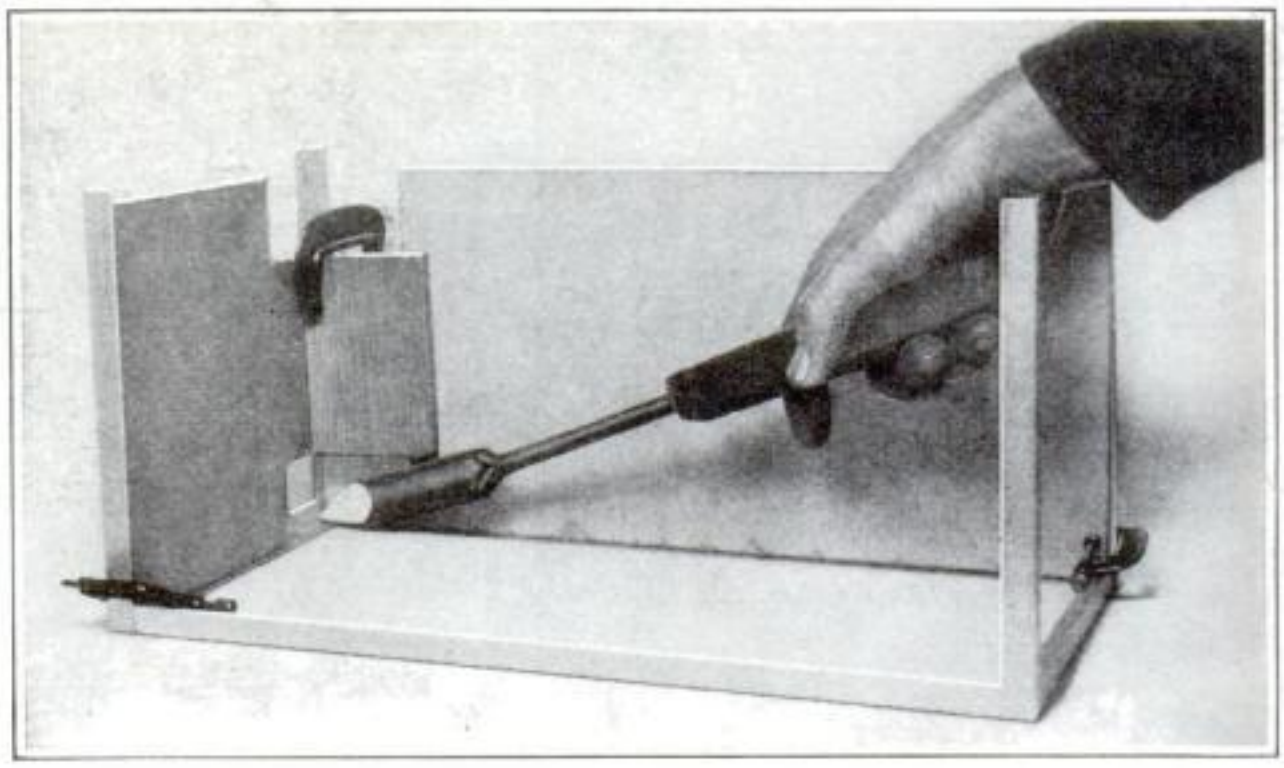


Fig. 3. Soldering the upright corner pieces, one at a time, to the bottom frame. The templates insure squareness, yet the notches allow the soldering iron to reach into the corners.

Assembling the framework is an easy matter if forms or templates are cut from fiber wall board as shown in Fig. 1 and used as in Figs. 2, 3, and 4. Begin with the top and bottom frames, which are identical, each being made from two pieces of angle stock 15½ in. long and two 8½ in. long. Assemble them over the rectangular wall board form and make a slight scriber line where one piece overlaps the other. Then remove the pieces and freshen the joints with emery cloth, and apply a killed acid flux (P. S. M., Jan. '30, p. 120).

With a hot, well-tinned soldering copper weighing about 1 lb., coat each piece thinly with solder wherever it is to be joined to the adjacent piece. This is called "tinning." Wipe away any excess solder with a cotton cloth before it hardens. Next apply fresh flux to each joint, clamp the work together as shown in Fig. 2, and apply the soldering copper freshly charged with solder to each joint. Hold the copper on the joint until you see the solder melt or "sweat in."

The same procedure is followed in soldering the 7½ in. long corner pieces to the bottom frame. Note in Figs. 1 and 3 how the side and end forms are notched and nailed to a block of wood in such a way that the corners of the frame can be easily reached with a soldering iron.

Excess solder may be scraped away and any scratches removed with a scotch (abrasive) stone and water.

For fastening the glass in place, you will need to use aquarium cement. An old and well-tried formula is as follows: 1 gill litharge, 1 gill very fine white sifted sand, 1 gill plaster of Paris, and ⅓ gill finely powdered rosin. Mix dry and then add boiled linseed oil and turpentine to make a putty.

Apply a layer of cement to the bottom of the aquarium frame in such a way that it will squeeze out in a flat, even layer when the bottom glass is pressed in place. If the putty knife is dipped into a mixture of linseed oil and turpentine, the cement will not stick to it. Dip your fingers in the same mixture before pressing in the fillets.

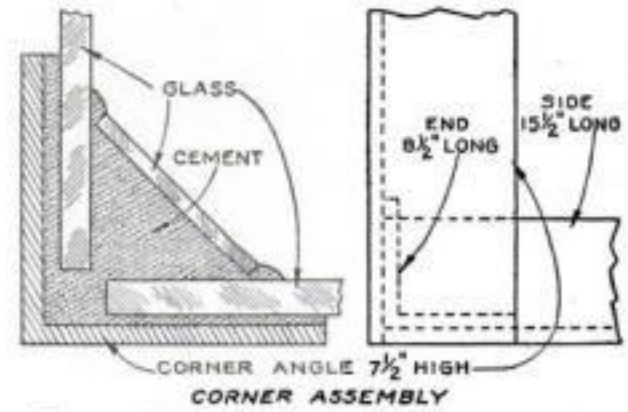


Fig. 5. How the frame members come together, and section of the completed corner.

When the bottom is in place, the side and end pieces may be set in cement. Then apply a generous fillet of cement in all the angles. While it may not be absolutely necessary, it is a good plan to press narrow strips of thin glass in these fillets as shown in Fig. 5.

Allow the cemented glass to stand for about twelve hours; then remove the excess cement with a razor-blade scraper or a wood chisel. Clean away finger marks with alcohol. Let the aquarium stand for at least two days longer before adding water, which should be changed once or twice before the fish are put in. Add aquatic plants to "balance" the aquarium. Common rocks of attractive shapes also enhance the appearance, as does a bottom of clean, light gravel.

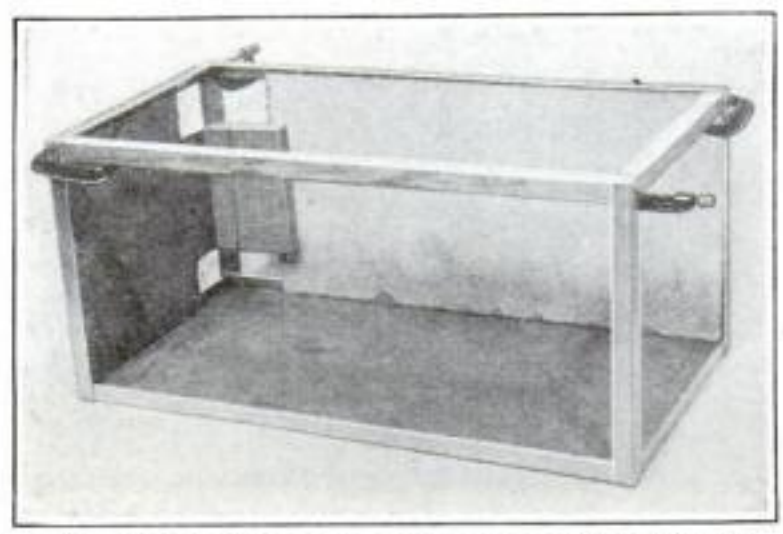


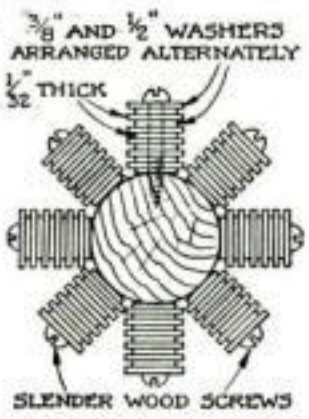
Fig. 4. The same templates are used in clamping the top frame to the uprights before soldering the joints.

MODEL AIRPLANE ENGINE MADE FROM WASHERS

SCALE model airplanes of the nonflying type can be equipped with realistic radial engines by building the dummy cylinders from small copper washers or riveting burrs. Use two sizes of washers arranged alternately as shown, and fasten each group to the nose of the model. The cylinders should correspond in number with those of the engine you copy.

I have found the best sizes to use are 3/8- and 1/2-in. washers about 1/32 in. thick.

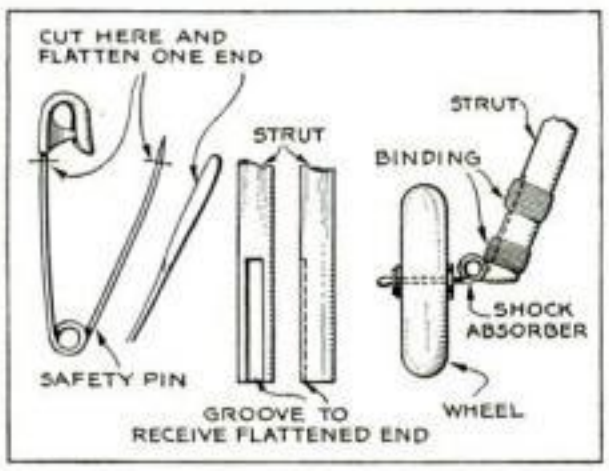
—M. J. KILLELA.



How to build up a model radial motor.

SHOCK ABSORBERS FOR FLYING MODELS

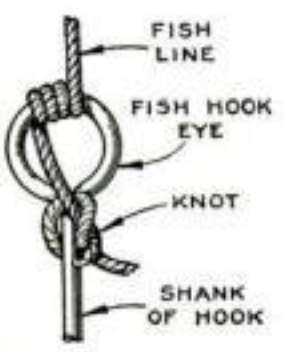
SAFETY pins can be converted into excellent shock absorbers for model airplanes. Obtain a pin of a size suitable for the model you are building; then cut off the ends as shown in the illustration below and slightly flatten the wire forming one leg of the remaining V. To receive this flattened leg, prepare a small groove in the center of the outside edge of the strut. Cement and bind the shock absorber in this groove and attach the wheel as indicated.—HENRY MARTIN.



How safety pins can be used to form practical spring shock absorbers for model planes.

A SNUBBING KNOT FOR TYING ON FISHHOOKS

AS A chain is no stronger than its weakest link, so is a fishing line no stronger than its knot, and most knots cut themselves at a strain of about three-quarters of the breaking point of the line. The accompanying illustration shows how one sportsman ties on his fishhooks in such a way that the knot is relieved of the direct strain. This is accomplished by snubbing the line four times around the eye of the hook before tying the end to the shank.—C. LIEB.



A fishing knot that will not cut itself.

Jack Hazzard *Tells How to Make*

A Tent without a Fault

For Auto and Canoe Camping

FOR auto or canoe camping the most convenient and comfortable tent is one that can be heated easily from a back-log fire and requires a minimum of pegs and poles.

Really comfortable tents are often prohibitive in price. Often, too, their dimensions are cramped or they cannot be well ventilated. The homemade tent shown is, however, quite free from all these disadvantages. It is mosquito-proof in the spring, cool in summer, and comfortably warm in the fall—a genuine three-season portable tent for four people.

Four pegs suffice to hold the tent proper, additional loops being provided for use in windy weather. The door flaps are so shaped that they may be extended in stormy weather to form a lee for a small cooking fire close before the door, or pegged at various angles to ventilate while still excluding wind or rain. It is when you awaken to the tune of steadily drumming raindrops that the additional, space-giving hood is fully appreciated.

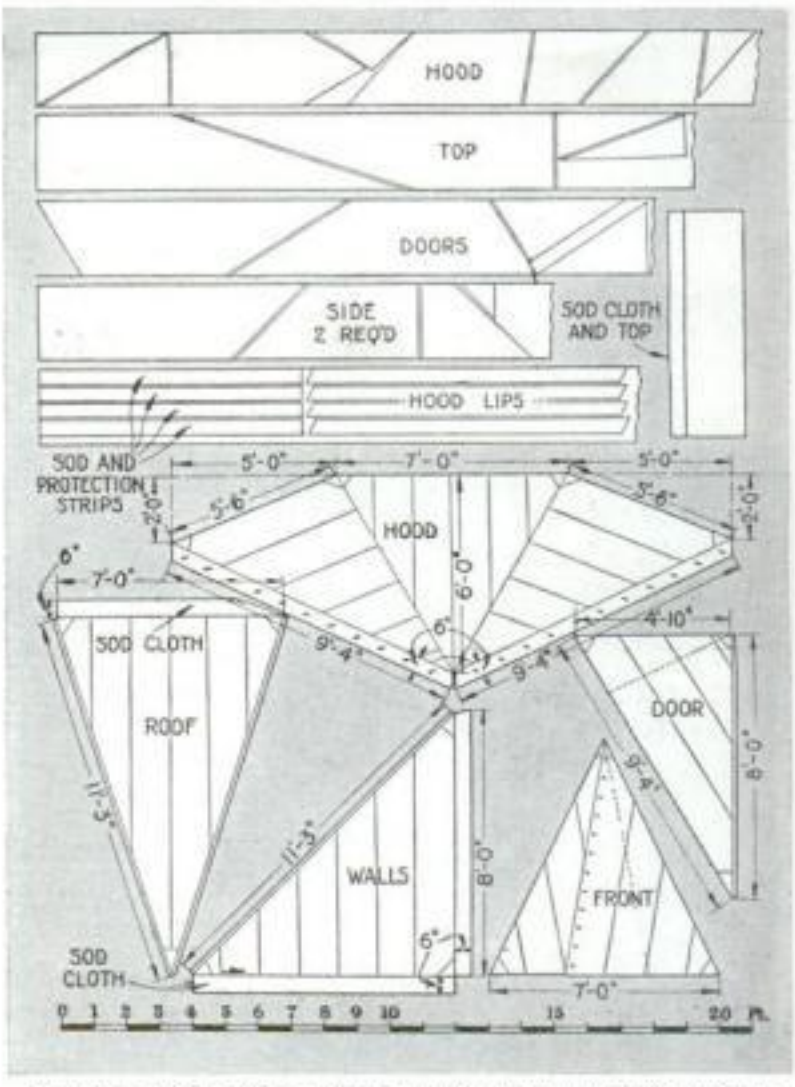
A good grade of unbleached muslin, properly shrunk and waterproofed by the sugar of lead and alum process, sheds water efficiently at the pitch afforded by this plan. Approximately 40 yd. of 28-in. material will be required.

Soak the muslin in cold water for twelve hours to remove sizing, and drain and squeeze off this water. Place the cloth in another bath and bring it slowly to a boil, allowing it to simmer for an hour or so. If the tent is to be dyed, this is the time to do it. While the muslin is still damp, iron it to remove the wrinkles. The material will shrink nearly an inch to the yard, and the texture will be just that much tighter.

Waterproofing should not be attempted until the tent is made up, as the cloth is more tractable before being treated.

The tent will be stronger and its appearance improved if a false seam is turned and stitched through the center of the material before it is cut. Seams ⅜ in. in width are amply strong when properly interlocked.

The matching breadth is folded and creased the opposite way, and the two pieces are interlocked and pinned together. Pinning, if carefully done, eliminates a tedious job of hand basting, and locking and pinning each breadth to its neighbor before it is cut from the bolt will assure proper allowance for hems and joinings



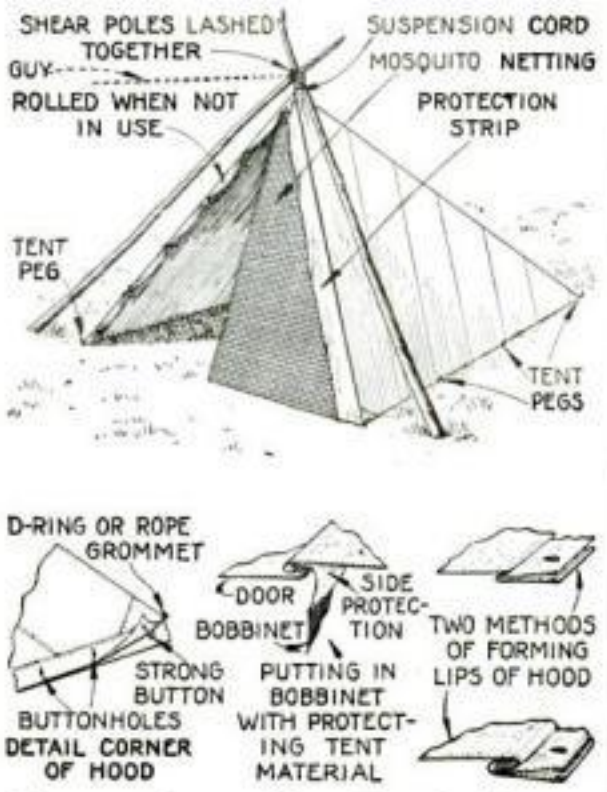
How the 28 in. wide muslin is cut and assembled to form the various parts that make up the complete tent and hood.

and eliminate errors in over-all dimensions.

Each panel should be laid out on the floor with a chalk line and nails, and the correctness of angles and dimensions checked carefully. Slip the cloth under the cord and mark the lines with a pencil. For joining panels and hemming loose edges, 1 in. is sufficient allowance, while for hems along the sod cloths and lips of the hood, ¾ in. will suffice. The allowances should be definitely marked with a pencil and rule.

It is good practice to complete all machine work on each panel before attaching it to its neighbor.

Braided cotton cord ⅛ in. in diameter should be laid in the seams joining the roof and walls of both tent and hood, as well as in the hem along the front edges



The mosquito-proof door, how the lips are formed, and detail of a corner of the hood.

of the hood. This cord should be shrunk before being placed in the seams. It should be fastened to the tent material every 6 in. or so with strong linen thread. The ends of the cord running through the joining of the roof and walls of the tent are turned back and "served" together, forming the peg loops at the rear corners.

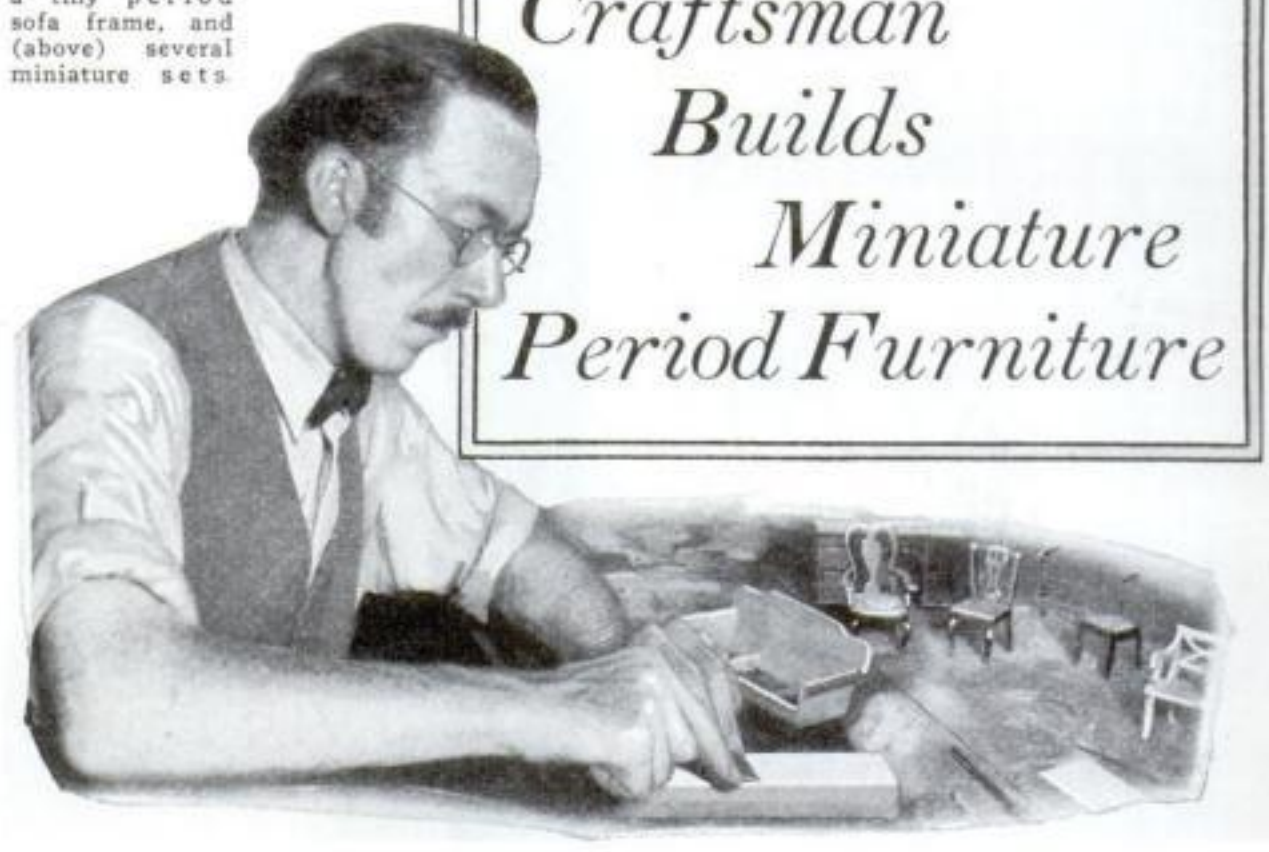
The net doors, when hanging straight, overlap nearly 1 ft. and drag on the ground an equal amount. The perpendicular edges are bound with tape, and to the ground edges are attached 6-in. pieces of tent material. Where the walls of the tent join the doors, a 6-in. piece is inserted, and the net doors are sewed to its free edge. To stow the net away and keep it safe from rough usage and sparks, it is rolled until protected by this cloth lip and then is tied with the cord "stops."

Two methods of forming the lips of the hood are shown in the illustration on page 120. One lip goes each side of the edges of the door flaps, the buttons of the underflap being pushed through the holes in the door edges and upper lips of the hood, thus fastening hood and doors securely together. When the tapes at the upper ends of the lips are tied, the fastening is complete.

The tent is suspended from "shears," a tripod, or an overhanging bough by means of a strong brass or galvanized ring sewed firmly into the peak with double linen thread and a buttonhole stitch.

Mr. Doyle preparing to carve a tiny period sofa frame, and (above) several miniature sets

Craftsman Builds Miniature Period Furniture



AFTER many hours of research spent in reading books and visiting museums, James Doyle, expert craftsman of Niagara Falls, New York, set about the task of building what he feels will be one of the most completely and authentically furnished doll's houses ever constructed.

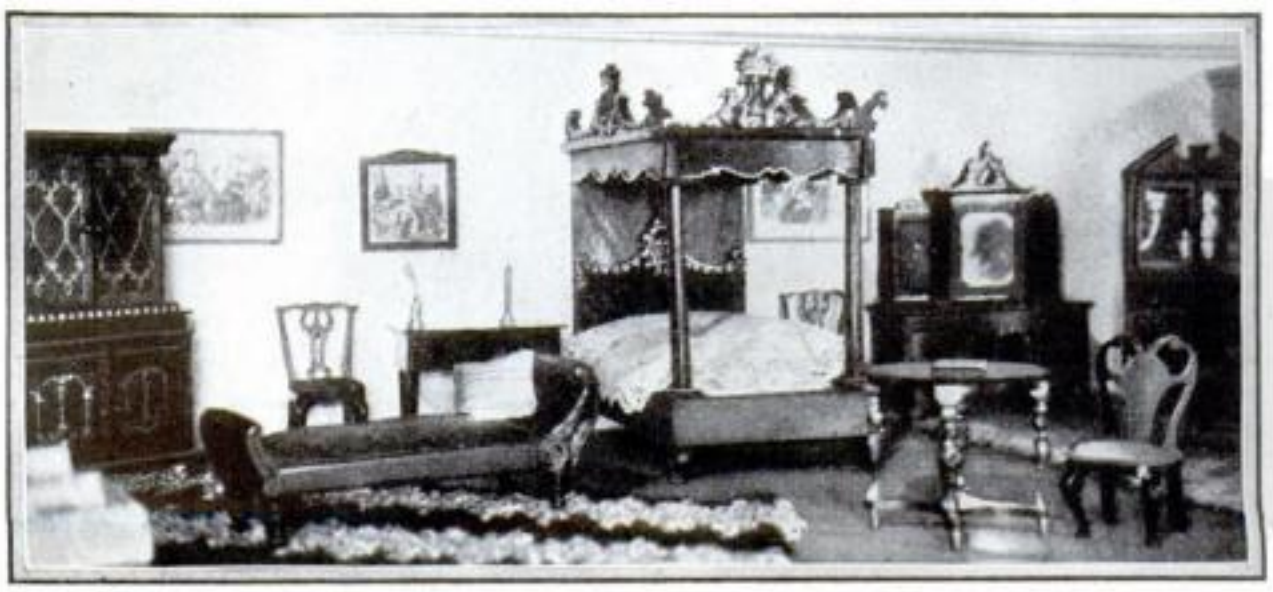
Each room in this "house of dreams," as he calls it, will be devoted to some particular period of furniture design, and each small piece, built to an accurate scale of 1 in. equals 1 ft., will be as near like its larger prototype as it is humanly possible to make it.

This interesting hobby had its beginning shortly after the baby daughter of a friend won her way to Mr. Doyle's heart. Wishing to give her a present that would be of enduring worth, he decided on this unusual type of doll's house, feeling that in such a project he could give her something that would be of sufficient cultural value to become a family heirloom.

Many of the small pieces are beautifully inlaid, while others are decorated with the most delicate of scrollwork. Each chair, table, and bed is a gem of handcraft.

When completed, the doll's house will be approximately 4 ft. square and 5 ft. high. Among some of the periods which will be represented are: Jacobean, Louis XIV, Queen Anne, and early American. The furnishings will be authentic miniatures of the work of such master artisans as Duncan Phyfe, Hepplewhite, and Chippendale.

Mr. Doyle is striving for accuracy above all else. In order, for example, that the wall paper in the tiny rooms should not be out of scale with the rest of the furnishings, he purchased special paper having a minute design.



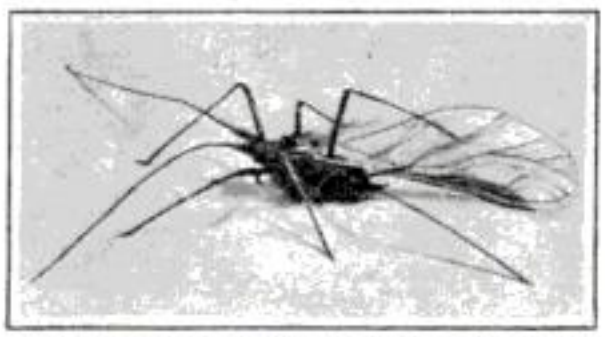
The furnishings for one of the bedrooms in Mr. Doyle's doll's house. The delicate carvings on the bed, which is less than 8 in. high, are an example of his exquisite craftsmanship.

Easily Mixed Sprays for Garden Pests

EVERY gardener has to guard against two kinds of insect pests, speaking broadly—those that eat the foliage and those that suck the sap. These require entirely different methods of spray control because poisons that kill sucking insects will not always destroy leaf-eating insects, and others that control leaf-eating insects rarely kill sucking insects.

Which kind of insect is damaging a plant can be easily determined by watching the injury. If the leaves are seen to be eaten, either wholly or partly, then caterpillars, worms, or other leaf-eating insects are present. When no noticeable injury can be found but the plant appears to be weak, the trouble is probably due to sap-sucking insects.

The leaf-eating insects are comparatively easy to control, for all that need be done is to cover the leaves with a very thin film of some stomach poison. There are a large number of proprietary spray compounds on the market, but home prepared sprays are less expensive.



A photomicrograph of an aphid, one of the more common of sap sucking garden pests.

Arsenate of lead can be applied in a stronger mixture than any other arsenical poison, and for this reason it is much used, especially for hard-to-kill insects such as beetles. Then, too, it can be safely mixed with Bordeaux mixture, a common fungicide.

This insecticide is easily obtainable, but can be prepared from 3 parts of crystallized arsenate of soda and 7 parts of lead acetate. Dissolve each in a small quantity of water and mix, adding from 2 to 5 oz. of the mixture to about 5 gal. of water; or mix the powdered chemicals directly in the water.

The addition of about 1 oz. of soap to each gallon of spray will make the spray adhere to the most glossy leaves, but this is necessary only when the mixture refuses to stick.

Red spiders and mites, which are so tiny they are almost invisible, can be controlled by spraying with finely powdered sulphur, 1 oz. in 10 qt. of water.

Sap suckers gradually abstract the sap from a plant and so weaken it that it falls an easy victim to disease even if it does not die outright. Some of the more common insects that do this damage are the scale insects, aphids, thrips, plant bugs, stink bugs, and leaf hoppers. A good percentage of them are found in the greenhouse and window garden as well as outdoors. The poisons used for their control are known as contact insecticides.

Aphids and thrips can be controlled

with 1 oz. of ordinary soap to 1 qt. of water. Heat the water and use while warm, but not hot.

Nicotine solutions or extracts of tobacco are also useful. Various types may be purchased, and a tobacco decoction can be prepared by boiling, in 1 gal. of water, tobacco stems or leaves, or both, to the weight of 1 lb. Just before using, add 1 oz. of soap and let it dissolve.

One frequently used spray mixture contains oil in an emulsion. The oil spreads over the insect's body and closes the breathing tubes, thus killing the pest. An emulsion useful against scale insects consists of 2 qt. of kerosene and 1 qt. of sour milk.

A more universal kerosene soap emulsion for general conditions consists of 1 oz. of powdered, bead, or flake soap dissolved in 1 pt. of hot water. To this hot soap solution 1 qt. of kerosene is added very slowly. Stir constantly, and if large quantities are being mixed, use a small beater or other mechanical mixer. This gives a stock solution. For scale insects, the stock solution is diluted with 10 parts of water. A general purpose spray is obtained by diluting 1 oz. of the stock solution with 1 pt. of water, or 1 part diluted with about 16 parts of water, but a greater dilution may be used with very delicate plants.—H. Bade.

AN INDOOR DRYER FOR HOSE AND LINGERIE

Small clips fastened to the hanger hold the silk hose.

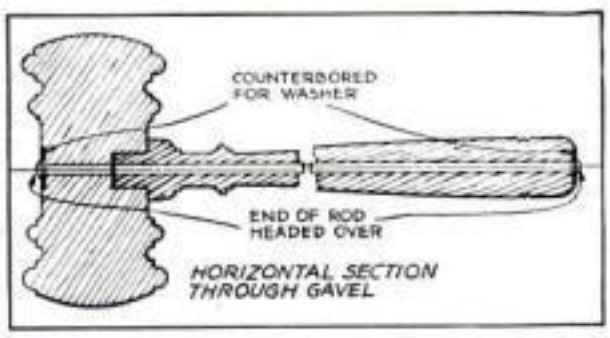
SILKEN garments must be laundered frequently, and it is often necessary to dry them indoors. For this purpose, the little dryer illustrated is convenient because it can be hung from any available projection. When not in service as a dryer, it may be used as an ordinary dress hanger, and undergarments and hose to match may be fastened to the clips so the complete ensemble is ready for wear.

The metal clips are strung on a ribbon which is thumb-tacked to the underside of the hanger in such a way as to have enough slack to permit their manipulation. If unpainted, the clips could be lacquered to match the hanger.—Gertrude Hazzard.

GAVEL HAS REENFORCING ROD THROUGH HANDLE

WHEN a student in a high school wood turning class, I was asked to design a gavel so the head would not fly off. My solution was to run a metal rod through the handle and head with a countersunk washer on either end of the rod, as shown in the accompanying drawing.

Drilling the handle true is not difficult provided it is done in the lathe before cutting off the waste ends. With a chuck and drill in the headstock and one end of the handle on the dead center, the handle is drilled as far as possible from one end; then it is reversed and the operation is repeated. To ream out this hole to exactly the right diameter, it is necessary to fashion a drill from a steel rod of the same size as is to be used in the handle, flaring the end slightly. Use this to drill to a point about halfway through the handle; then reverse the handle as in the drilling process.—EDWARD B. SPAULDING.

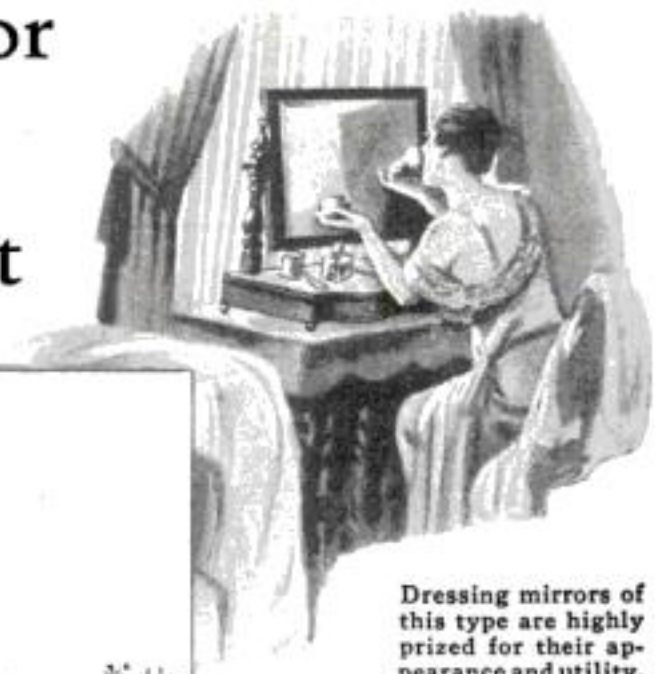


Sectional drawing of the gavel showing the reënforcing rod and the countersunk washers.

CUTTING HOSE WASHERS

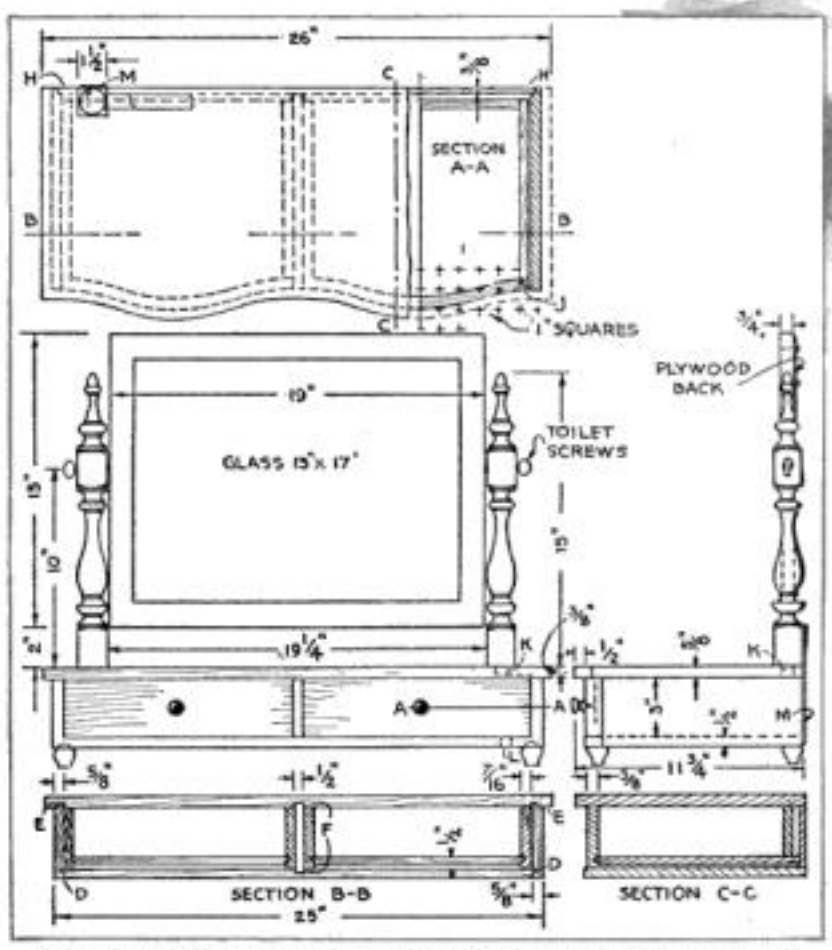
SATISFACTORY garden hose coupling washers can be cut from pieces of old hose. A guide to aid in the cutting can be made by boring a hole the same diameter as the hose in a block of wood and inserting the hose through it until it projects about ⅛ in. Do the cutting with a wet knife and then scale away some of the outer rubber until just the right diameter is obtained.

A Dressing Mirror *with a* Serpentine Front



Dressing mirrors of this type are highly prized for their appearance and utility.

By CHARLES A. KING



By following these working drawings, any reasonably skillful woodworker will find it easy to build the toilet case.

WITH this movable toilet case or dressing mirror, a bureau, a table, or even a tastefully draped packing box can be changed into a convenient dressing table. Since the design suggests the late eighteenth century, mahogany seems the most suitable wood, although either walnut or red gum will be an excellent substitute.

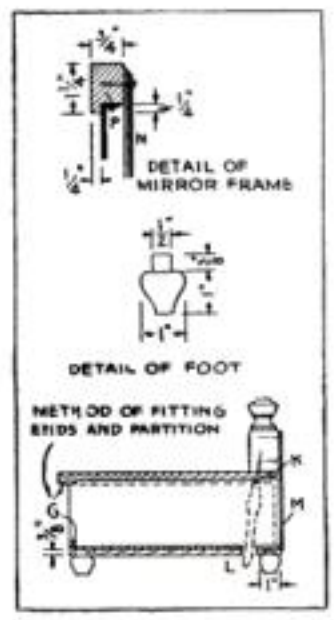
While the drawings call for a grooved construction, plain butt joints may be used and the case assembled with brads. It is easy enough, however, to make the tongues and grooves if you own an outfit of light woodworking machines; or you may take the pieces to a mill to be machined, or even cut the grooves by hand with a chisel between deep gage lines. At any rate, we shall assume that grooved construction is to be used.

Prepare the top, which is ⅝ by 11¾ by 26 in., and the bottom, which is ½ by 11¼ by 24⅛ in., but do not shape the front edges at this time. Make the partition ½ by 9⅞ by 3⅜ in. and the two ends ⅝ by 10¼ by 3 11/16 in., and have the grain run the short way of each piece. These dimensions allow for 3/16-in. tongues to enter their respective grooves *D* and *E*, also for the partition to enter its grooves *F*.

Lay out and cut grooves *D*, *E*, and *F*, being sure they coincide with each other and that the drawer spaces are parallel. Stop the grooves about ⅜ in. back of the front with a shoulder as at *G* in the drawing at the bottom of this page. Be sure that grooves *F* fit the partition closely.

Cut the rabbets on the top of each end piece to fit grooves *E* and cut the rabbets on each end of the bottom, stopping the front edge against the end with a shoulder as at *G*. Be sure distances between the shoulders of the bottom and the grooves *E* of the top are equal. Cut a ¼ by ⅜ in. rabbet in the back edge of each end as at *H* in the plan view and assemble all pieces, fastening them temporarily.

The pieces from which the drawer fronts are to be made should be 1¾ by 3⅛ by 12 in. to allow ample wood for fitting. The drawer fronts may be of mahogany or of other wood veneered; if the latter, a piece of mahogany ¼ in. thick should be glued on the top edge to show when the drawer is open. If figured or "crotch" grain is desired for the drawer fronts, the mahogany fronts may be veneered. In this case the sawed-off waste pieces will serve for the cauls.



The interior construction and details of mirror frame and feet.

Make a full size template of the drawer front by transferring the squares and curves of section *A-A*. Bandsaw the curves and smooth carefully to maintain ⅝-in. thickness—more rather than less, but parallel in any case. Trim the drawer fronts to fit the case opening closely and push them into their exact places, being sure the curves flow into each other gracefully. Pencil mark the line of each drawer front on the bottom and on the underside of the top. Take down the assem-

bled case, measure ½ in. beyond the line on the underside of the top, and work both pieces to the exact shape. Smooth and sandpaper all exposed surfaces and assemble permanently with glue and brads. Fit the ⅜-in. back and brad in place.

Prepare four drawer sides 7/16 by 3 by 9½ in., two backs 7/16 by 2⅜ by 10¾ in., and two bottoms ¼ by 10½ by 11⅛ in.; verify these dimensions before cutting the stock. Make 3/16 by 3/16 in. grooves in the drawer sides and front as shown. Fit the front edge of the drawer bottom to the front groove. The drawer front and sides may be milled with a lock joint as at *J* of section *A-A*, or they may be rabbeted, glued, and bradded, or even dovetailed if the worker wishes to take that trouble. The drawer back is cut in square and bradded, although it may be grooved in by adding ⅜ in. in length to the back.

Make the turnings 1½ by 15 in., finished length, with a ½-in. dowel ⅜ in. long on the bottom as at *K*. Locate them carefully and bore ½-in. holes in the top to receive the dowel. Bore a ½-in. hole in the bottom at *L* to allow a screw driver blade to be inserted for driving a screw into the turning at *K*. Fit a piece of ⅛ by 1 in. iron in the back at *M* to strengthen the joint.

Make the mirror-frame molding as shown in the detail, miter the joints, and glue and nail the pieces together. Fasten a plywood back temporarily as suggested at *N*. Fit regular toilet screws to hold the mirror and attach a brass knob to each drawer. Make four feet and fit and glue them in place.

Remove the metal trimmings and stain the wood, if desired, or darken it by using a solution of bichromate of potassium. Give several thin coats of orange shellac, sanding each coat with No. 4/0 sandpaper. If a dead or matte finish is desired, rub the last coat with sandpaper dipped in linseed oil and wipe off with a soft cloth and rottenstone. If a velvet finish is preferred, polish with wax.

Place the mirror in the frame, fasten with three-cornered blocks glued or bradded as at *P*, put on the plywood back permanently with ¾-in. No. 8 roundhead screws, and replace the metal trimmings.

CHEAP CLEANER FOR LACQUER BRUSHES

[redacted] expense of lacquer thinner has [redacted]ted you to put away lacquer [redacted] without cleaning them with absolute [redacted]oroughness, take a pint bottle to a [redacted]or paint store and have it filled with [redacted] parts of denatured alcohol and acetone. This is practically as effective as the [redacted]ner for cleaning the hands and the [redacted]shes, although the brushes might have a final dipping in thinner.

When using a small electric spray with lacquer, it is well to keep one jar with some of this cleaning mixture in it. If the work is interrupted and there is danger of the tubes becoming clogged, change jars and blow a little of the alcohol-acetone fluid through the spray gun. This evaporates and the spray is left clean.—C. E. L.

Tips on How to Develop Your Skill in Wood Turning

By W. CLYDE LAMMEY

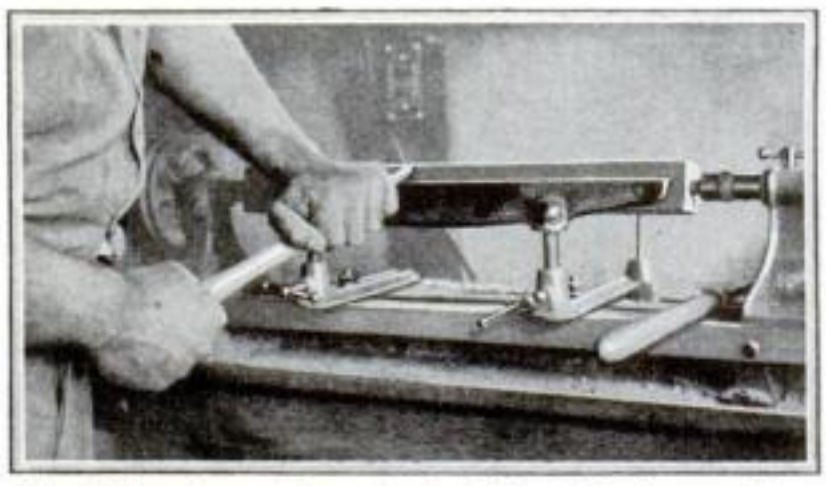


Fig. 1. How the turning gouge should be held when roughing square work. The chip should be "scooped" from the surface.

WOOD turning is done in two ways—by cutting and by scraping. The difference between them depends on the position of the tool rest and the angle of the cutting edge with relation to the work. On faceplate work, scraping is done almost exclusively, but on work between centers the tool ordinarily is held in such a position that it will cut rather than scrape off the chip.

Special attention is called to Fig. 1 and the sketch *A* in Fig. 2, showing a gouge in position on the rest for the roughing cut on work that is 2 in. square (commonly 1¾ in. in actual finished dimensions). For work from 1½ to 2 in. in diameter, the rest should never be less than ¼ in. above the plane of the axis or less than ¼ in. from the arc struck by the revolving corners. On work larger or smaller, whether in the square or the round, the rest should be placed accordingly.

From the sketch *A* it will be seen that the bevel of the tool is very nearly tangent to the arc and that the chip is "scooped" or lifted off, also that the cutting is done well up on the top half of the arc. When held as shown with the handle down, the tool is far easier to control; and because the cut is made well above the axis, most of the vibration of the work is eliminated. Moreover, the tool will cut very fast and leave a clean, smooth surface free from chatter marks.

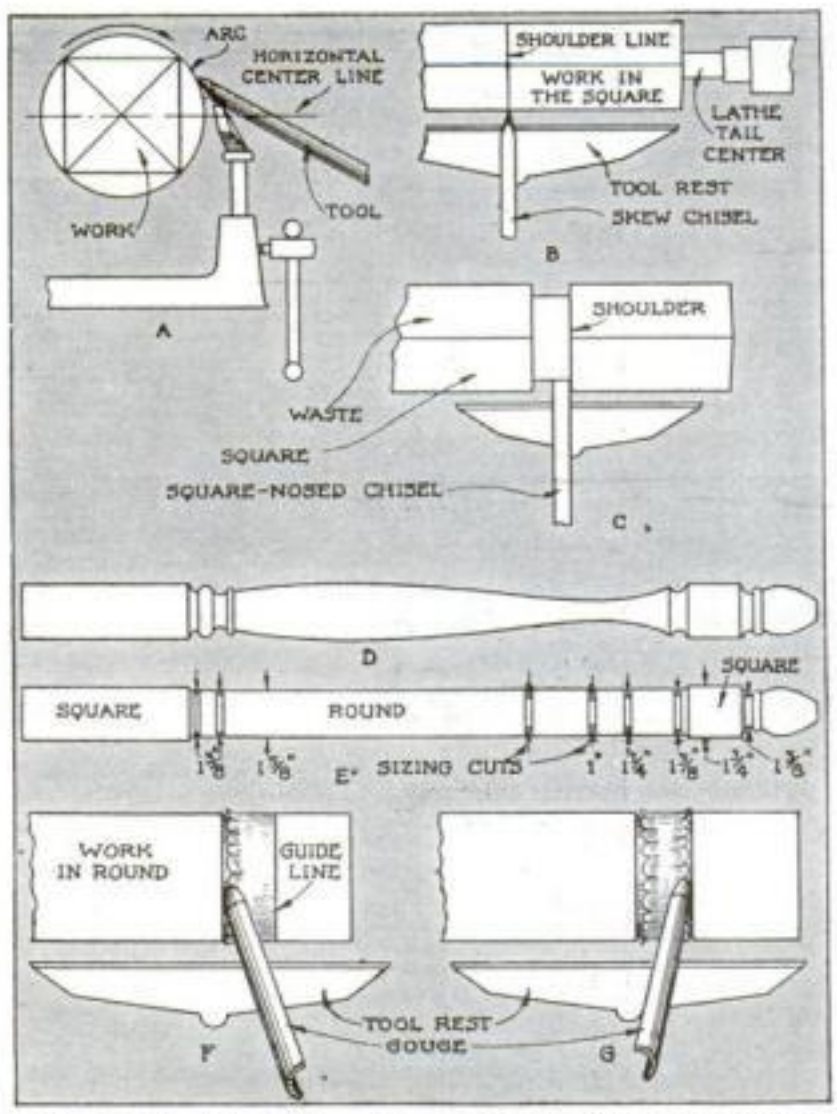


Fig. 2. Roughing (*A*), cutting a shoulder (*B* and *C*), laying out a turning (*D* and *E*), and making concave cuts (*F* and *G*).

The position of the tool and rest is one of the most important phases of lathe work between centers. A fair rule is to keep the handle of the tool approximately 30° below the horizontal. While square- and round-nosed tools may be fed in at right angles to the work, the gouge or skew chisel always should be held at an angle to the axis of the work, both vertically and horizontally. This rule will not apply full to the parting and diamond tools, as these are essentially scraping tools.

After being roughed down to a cylinder, the average piece of work between centers may be finished almost wholly with variations of shoulder, concave, and taper cuts. At *E*, Fig. 2, is shown a typical leg turning laid out on a 1¾-in. square 29 in. long. The shoulders should be cut down before the

main portion is roughed into the round.

The best method of cutting down a square shoulder in ordinary work such as this is shown at *B* and *C*. First, square heavy lines across all four faces to mark the divisions between the parts to be left square and those to be turned. Then turn the skew chisel upside down on the rest with the toe of the chisel down and check the corners by running straight in, holding the handle level. Next run down the shoulders as at *C* by making alternate cuts with the square-nosed chisel, the corner of the tool coming exactly to the line and running straight in. The alternate cuts are necessary to prevent binding, and the

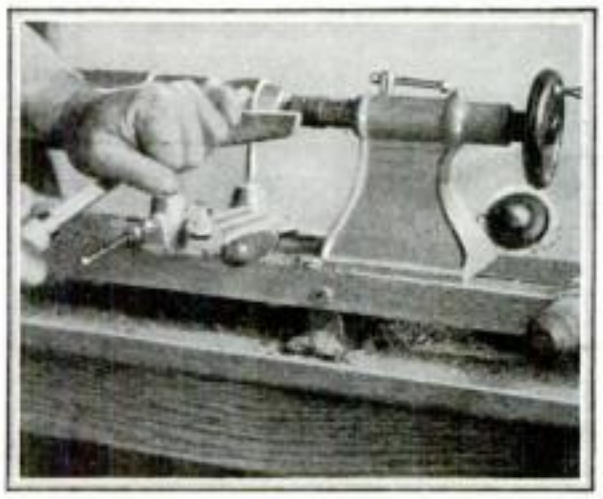


Fig. 3. In making a paring cut with a skew, the tool is held at an angle to the surface.

checking with the skew chisel is essential to offset the tendency of the corners to splinter off. Merely run the work into the round, but do no more or it will be undersize.

When the shoulders are cut, rough out all the round parts with the gouge. Be very careful that the tool does not strike the corners of the squares, for when held flat on the rest the gouge tends to pull into the high places.

Deep and narrow concave cuts are best made with the round-nosed tool fed straight in and moved sideways to widen the cut. The handle should be kept down so that the tool does not tear and leave the work rough.

Where a number of similar leg turnings are to be made, it is best to size the work with the parting tool and calipers.

Figure 2 at *F* and *G* shows another method of cutting down concave parts of the design provided the width of the cut is at least twice that of the turning gouge. Although this operation is a bit difficult to master, it is well worth the while. Every amateur turner knows the difficulty of effectively sanding concave cuts so that they will take a satisfactory finish. With

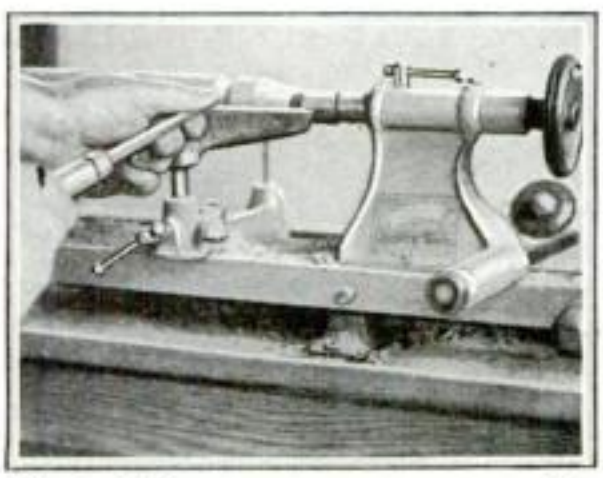


Fig. 4. Shallow, narrow concave cuts can be quickly made with the round-nosed chisel.

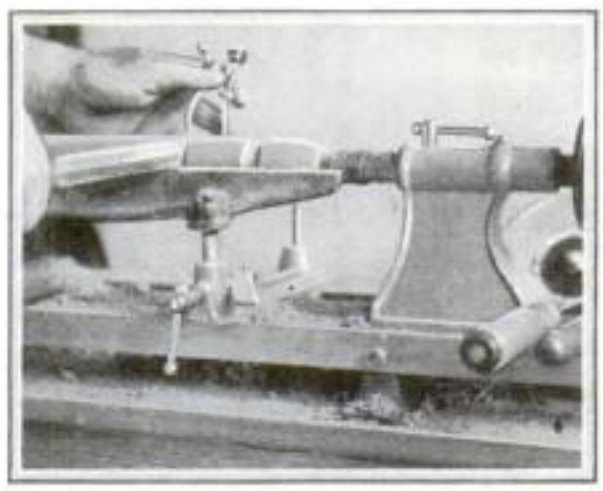


Fig. 5. How the calipers and the parting tool are held when making the sizing cuts.

the method illustrated, sanding is entirely eliminated and a glass-smooth finish is left over the entire surface.

Roll the gouge about three quarters over and swing the handle to the right as at *F*, Fig. 2. This brings the top side of the cutting edge at right angles to the work. Raise the handle slightly until the edge begins to cut; then roll the tool counterclockwise and raise the handle slowly and steadily. Run the cut to a depth of about ¼ in. and repeat the identical operations in reverse, as at *G*. Then make a single cut at the center (the tool held flat) to break off the chips. Repeat the operations from each side until the cut is the required depth.

This is one of the neatest of all tool manipulations on work between centers

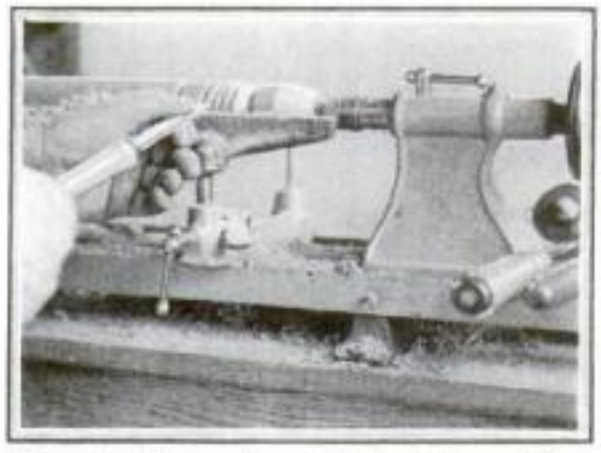


Fig. 6. A diamond-point chisel is used for sinking the recesses between adjacent beads.

and produces the finest possible surface.

Where a number of beads are to be made of the same size and close together, cut down the spaces between, by running straight in with the diamond tool (Fig. 6), and round over the beads with the square-nosed chisel. Rough out bulbs, oval shapes, and long tapers and curves with the gouge and finish with a skew chisel held at an angle with the work both vertically and horizontally (Fig. 3). Take light, paring cuts and be very careful that the toe of the edge does not catch in the wood. If careful work has been done, very little sanding, if any, is required to finish the turning, and then only a very fine grit paper should be used to avoid scratches.

Though they are both used in some instances, the gouge and the parting tool are largely dispensed with in faceplate work. Here, the tools must of necessity be used as scrapers. The tool rest requires to be set about ⅛ in. under the axis when working on the face, and the cutting edge must be held more nearly at right angles to the face of the work. The turning is

first rough-faced and edged with the round-nosed tool and scraped smooth with the square-nosed chisel. Then the necessary curved cuts, concaves, and beads of the design are worked out with the round-nosed and diamond-point tools.

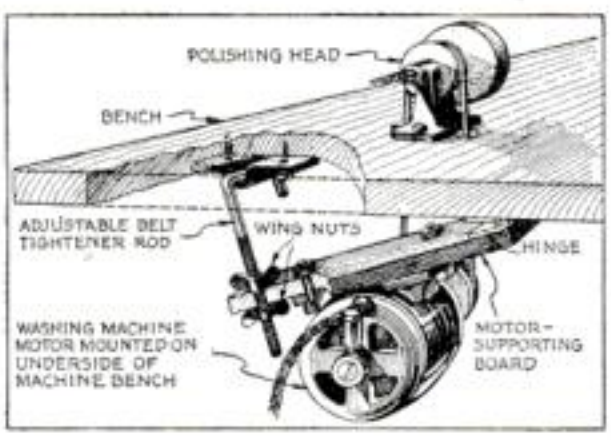
Work between centers and on the face-plate always should be turned at the highest speed possible without vibration; that is, where the headstock allows a variation in speed. On a constant-speed, direct motor-driven lathe, work that is more than 1¾ in. square will sometimes vibrate unduly. If the design will permit, saw off the four corners diagonally outside the finished dimensions; if not, the trouble generally can be remedied by recentering the dead center very slightly until the work runs evenly.

This is the second of two articles by Mr. Lammey on wood turning. The first (P.S.M., May '31, p. 94) gave pointers on the care of the lathe, on how to grind and hone wood turning tools, and how to center the work. Other articles on the use of small woodworking machines will follow.

UTILIZING OLD WASHING MACHINE MOTORS

MANY washing machines are discarded because they are obsolete in design and unsatisfactory in operation, but their motors are usually in good condition and can be salvaged for other purposes, such as driving small home workshop machines. The first question that arises, however, is how to mount the motor.

One method that is simple and practical is to bolt the motor to a board which is hinged beneath the bench top in the manner illustrated below. A J-shaped threaded rod with two wing nuts holds the motor board in position when the desired belt tension is obtained.—B. G. S.



In this ingenious arrangement, the tension of the driving belt can be easily adjusted.

EASILY CLEANED MIXING BOWL FOR CEMENTS

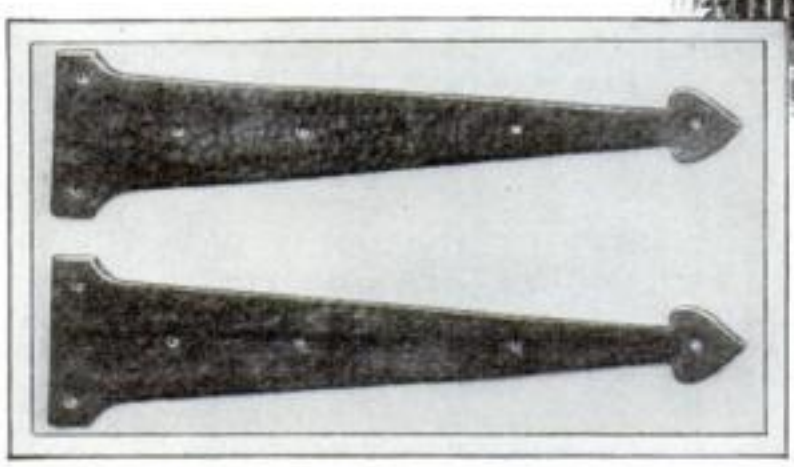
ANYONE who has occasion to prepare small quantities of quick, hard-setting mixtures such as litharge and glycerin, plaster of Paris, plain water putty, and similar materials will find that he can do the work quicker and with less muss if he will use one half of a small rubber ball as a mixing bowl. Hardened left-over materials can be removed readily by twisting the rubber or turning the half ball inside out. The size of the bowl makes it particularly handy, as it will fit in the palm of the hand.—CARL O. LANDRUM.

IMITATING FINE HARDWARE WITH LEAD

MANY a home owner has noticed the wrought iron hinges with which architects so often ornament the massive doors of fine residences. Because it is both unusual and decorative, this type of hardware gives a touch of genuine individuality, but it is expensive. For a few cents, however, anyone can imitate a pair of these attractive hinges and, at the same time, have the pleasure of being able to say that he made them himself.

Lay out a cardboard pattern like the one illustrated, or draw an original design. The size naturally depends upon the proportions of the door and the length of the butt hinges already on the door. The pattern given is for a 17-in. hinge strap, and it is intended to be used with 4-in. butts.

After cutting out the cardboard, obtain



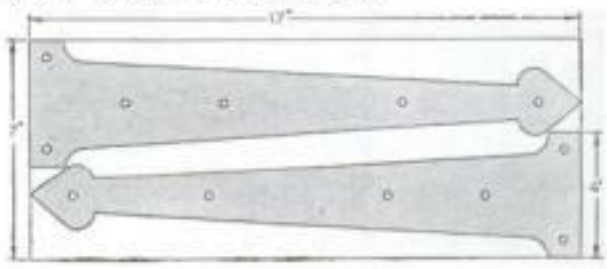
A pair of hinge straps made from sheet lead. They resemble wrought iron and have the advantage of never rusting.

a piece of sheet lead 7 in. wide and 17 in. long from a local plumbing shop, and transfer the outline to it by scratching around the pattern with an awl or a nail.

With a pair of tin shears, cut out the two parts. Trim up the edges with an old knife, and hammer all over one side of each with a ball pein hammer. Use the flat face of the hammer to bead down, or bevel, the edges. Then drill holes for the screws or nails.

To apply the straps, place the heel of each against the projecting butt hinge, already on the door, and fasten in place with squarehead nails or roundhead blued wood screws.

While lead bends readily, it will stay in place indefinitely when fastened flat against the door. Close inspection will be required to distinguish the completed straps from wrought iron hinges, and better still, they will not rust.—DICK HUTCHINSON.



How the two straps are laid out on the lead so they can be cut with the minimum waste.

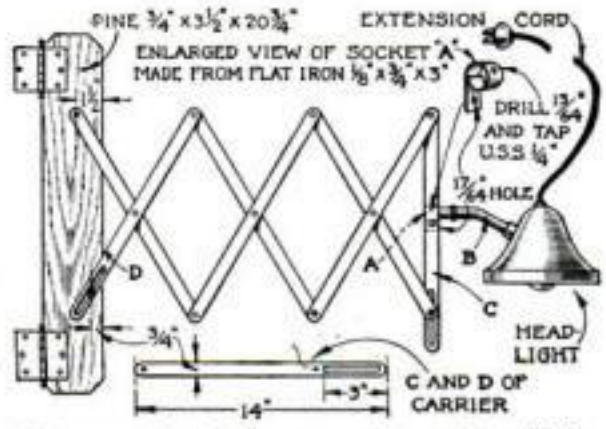
CHEAPLY MADE EXTENSION SHOP LIGHT

AT PRACTICALLY no cost, a convenient, heavy-duty extension light for the home workshop can be made from an old automobile luggage carrier, a headlight and reflector, two door hinges, an old extension cord and key socket, a scrap piece of pine, and some washers, bolts, rivets, and paint of the desired color.

The only part that involves any difficulty is the connector or socket *A*, which is made from flat iron by heating the metal and bending it over a piece of round stock of the proper size. This part is fastened to the carrier with a ¼-in. stove bolt; then the end of part *B* of the headlight is slipped into *A* and held with a set screw.

The extension cord may be fastened in the hole in the back of the headlight with a hollow cork.—DONALD J. MARTIN.

A heavy-duty mounting for a shop light constructed almost entirely from scrap parts.



The extension luggage carrier and headlight are supported by a board hinged to the wall.

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MAGIC PLATES TAP SUN FOR POWER

(Continued from page 41)

figures. A modern hydroelectric plant of the same output costs between $100 and $300 per kilowatt to build.

If this dream of power from the sun is realized, it will go far to make industry independent of the fast-dwindling coal supply of the world. The cost of operation, once a solar-electric station is constructed, would be negligible, according to the inventor. The current could be produced at a low rate in sections where sunlight is frequent.

Besides the promise of running huge machines with sunshine-created power, the new plates produced by Dr. Lange offer additional possibilities of many kinds. One use proposed is an automatic recorder for determining the correct time of photographic exposures. Also, because the metal plates are sensitive to infra-red rays, which penetrate fog but are invisible to the human eye, they may be employed in receiving signals on board ships and airplanes moving through thick mist. Again, they will indicate the direction of the sun to an airman lost in clouds of fog.

ONE of Germany's largest liners is soon to be equipped with an automatic fire control system, using such a light-sensitive apparatus. Air from various parts of the vessel will be pumped through tubes so it passes before the photo-electric device. When smoke is in the air, the light shining on the apparatus is obscured and the current flowing from the device suddenly decreases. This sets off an alarm which indicates the exact spot from which the smoke is coming.

For some years, photo-electric cells of various kinds have been employed in tasks of seeming magic. They usually have the appearance of incandescent light bulbs and are coated inside with potassium or caesium, which gives off faint impulses of electricity when struck by light.

However, the greater amounts of power flowing from the strange metal plates just announced in Germany increase their effectiveness for many photo-electric tasks, besides making them an important step in the direction of tapping the energy of the sun.

This dream of making the sun turn our factory wheels has occupied many experimenters.

A few years ago, a French scientist proposed a unique solution to the problem, suggesting a battery of thermocouples that would change sun-heat into electric current. These instruments, consisting of fused joints of two different metals, create a flow of electricity when one of the metals is heated.

THE explanation for the phenomenon is that identical volumes of two different metals inclose different numbers of free, or current-carrying, electrons. Heat increases the activity of the electrons and the excess of them in one metal flows to the other, setting up an electric current. So sensitive are some thermocouples that they are affected by heat of a burning candle six miles away.

By burying more than 400,000 large thermocouples in concrete, so the lower ends would be in the cool ground and the upper ends exposed to the hot rays of the sun, the French scientist suggested that large quantities of cheap sun-created electricity could be obtained. The cost of a trial was prohibitive and nothing ever came of the plan.

Dr. Lange's metallic sandwiches will be comparatively easy to test on a gradually increasing scale. In the near future, he plans to connect a number of the magic plates together in a unit, thus taking the next step toward large scale production of electric current from the light of the sun.

HOW MAN WAS CREATED

(Continued from page 19)

DR. GREGORY: The earth, you might say, still had growing pains. Yet it was then at least a billion years old, for astronomers and geologists put the age of the earth now, in round numbers, at two billion years. Do you know how the earth itself originated?

MR. MOK: I have an idea, but I would like you to tell me.

DR. GREGORY: All right. This earth, which seems so big and important to you and me, but which is only a microscopic speck in the universe, was born as a result of a traffic accident.

MR. MOK: Are you joking?

DR. GREGORY: Not at all. Once, astronomers believe, the earth was part of the sun. It was literally torn from its father's body by another passing star. The sun itself, of course, is a star, one of the two billion now known to astronomy. All of them careen through space like birds wheeling about in a vast aviary. The sun spins at the rate of thirteen miles a second.

MR. MOK: What happened?

DR. GREGORY: Eons and eons ago, when the sun, which was then much bigger and hotter than it is now and which had no planets, was drifting about in this way, something began to go wrong with the celestial traffic. Another star was gradually approaching. There was no danger of collision, but it came close enough to exert its attraction on the sun. It was so strong that it pulled great flaming streamers out of the sun. As the other star moved on, the sun must have had the appearance of a gigantic pin-wheel.

MR. MOK: The earth, then, was part of one of these streamers?

DR. GREGORY: Exactly. The new, blazing "arms" of the sun were great jets of white-hot gaseous solar matter. Some of this slowly condensed, and formed eight planets and some of their moons. One of these planets was the earth. Compared with the sun, it is as small as a pea beside a basketball.

MR. MOK: When life finally appeared here, was the earth hotter than it is today?

DR. GREGORY: Not much, if at all. The continents had long been formed, though they were different in shape from now. The waters, too, had been gathered into oceans for millions of years. And, to go back to astronomy for another moment, the earth and the other planets had settled down nearly in their present orbits, that is, the paths in which they travel around the sun. And then there happened on this barren, lonely earth what I consider the greatest wonder of all—the birth of life. It was only a little scum floating here and there in pools and puddles, but it was the most important thing that ever occurred here.

MR. MOK: How do you know that man evolved from these first tiny life germs?

DR. GREGORY: We really do not *know* it as we know that two and two make four, or that Lindbergh flew to Paris on May 20, 1927. There is no absolute proof. And, naturally, nobody was there to see it and record it. The evidence, as lawyers say, is circumstantial. We deduce it from three facts we do know.

MR. MOK: What are these facts?

DR. GREGORY: In the first place, man *still* develops from a single life germ, a fertilized egg cell. Not only man does this, but a cow, a snake, a canary, a flounder, an ant, a worm, and an apple tree—in fact, all living things—do the same thing.

MR. MOK: And the second fact?

DR. GREGORY: It is this: Every living thing, you included, grows to full development through the *(Continued on page 136)*

HOW MAN WAS CREATED

(Continued from page 135)

division and subdivision of this one cell into colonies of cells. Every particle of your body, every cubic inch of your muscles, bones, eyes, brain, consists of cell villages, cell towns, cell cities, each with myriad inhabitants that depend one upon another for their existence. Have I made that clear?

MR. MOK: Yes. Please go on.

DR. GREGORY: The third point is that not all cells have to gather into such commonwealths in order to live. Some can and do live by themselves. You can see them for yourself if you take a drop of water from a puddle and examine it under a good microscope. You will see thousands of tiny animals and plants which you did not suspect existed. Besides, you will notice minute formless specks of slime, little grayish drops of jelly that continually change their shape. These are amoebas. They consist of only one cell each. Yet they breathe, eat, grow, and multiply. In short, they are living creatures.

MR. MOK: It seems to me that your three facts show three things: that all living things consist of cells, that they grew out of one cell, and also that single cells can live alone. But there is one thing that I still don't understand.

DR. GREGORY: What is that?

MR. MOK: Why do scientists believe that all life developed from the *same kind* of cell? In other words, on what do you base the idea that those little specks of slime that floated around in puddles a billion years ago were the ancestors of man?

DR. GREGORY: In our own bodies, besides the cells that live together in colonies, there are billions of individual cells, that live alone and independently, just like amoebas. They belong to us, and yet they are not attached to us. They are boarders, free to come and go as they please within our bodies. They pay for their keep by fighting our battles. They are the white corpuscles in our blood. It is the task of these white corpuscles to devour disease germs the moment they appear.

MR. MOK: Very interesting. But I still don't see where that is any evidence that man evolved from your little blobs of jelly in the primeval puddles.

DR. GREGORY: You will in a moment. The curious fact is that the fighting cells in our blood and the amoebas in the roadside ditch are cousins. Their lonely and independent mode of living is not the only way in which they resemble each other. They look alike. They breathe, move, eat and multiply in the same way. Most important of all, they are composed of the same substance.

MR. MOK: Now I see what you are driving at.

DR. GREGORY: I thought you would. The substance of which both the amoebas and the white blood cells are made is a jelly-like stuff that looks like raw white of egg, though it is usually not quite so liquid. It is called protoplasm. And now I am coming to the evidence that you seem to want so badly. Not only the white blood cells and the amoebas, but *all* cells contain this protoplasm. In other words, you and I, the cow, the snake, the canary, the flounder, the ant, the worm, and the apple tree, everything that lives, are mainly composed of living material that is basically the same in all. Now, are you satisfied?

MR. MOK: Perfectly. That explains on what scientists base the idea that all life sprang from a common ancestor. I also see now how you know what the first life cells must have looked like.

DR. GREGORY: Yes, but don't imagine that the original cells resembled the present amoeba or white blood corpuscle in every detail. The first life germs were much simpler. In the thousand million years since it first appeared, protoplasm has undergone many, many changes. It has been adapted, slowly and gradually, to the millions of uses to which it has been put. These uses became more and more complex as life evolved. Therefore, a cell from your brain, for example, is as different from the first life cell as the modern automobile is from a primitive oxcart. But, just as in the case of the motorcar and the oxcart, one developed from the other, and the basic principle still is the same in both.

MR. MOK: You said that the amoebas in a puddle and the cells of our blood breathe in the same way. Will you please explain that?

DR. GREGORY: I am glad you asked that question, because by answering it we will get at the heart of the whole business. The fundamental mystery about the early life germs was that they could breathe. That is one of the main reasons why they lived and could survive. Do you understand what happens when you breathe?

MR. MOK: I take air into my lungs. The oxygen in the air is passed on to my bloodstream.

DR. GREGORY: That is right. What really happens is this: When you breathe, the oxygen from the air you take into your lungs is carried by the red corpuscles of the blood to the cells in every part of your body. The cells use the oxygen, and return to the blood a combination of oxygen and carbon. This compound is called carbon dioxide. Like oxygen, it is a gas; the same gas that makes the bubbles in soda water. Now, the red corpuscles take in the oxygen through their surface. That is precisely what an amoeba does. Therefore, an amoeba and a blood cell breathe in the same way. Does that answer your question?

MR. MOK: Yes. But what exactly did you mean when you said that the cells in every part of the body "use" the oxygen?

DR. GREGORY: One of the principal ways in which they use it is by combining it with the carbohydrates in our bloodstream. This combination produces energy.

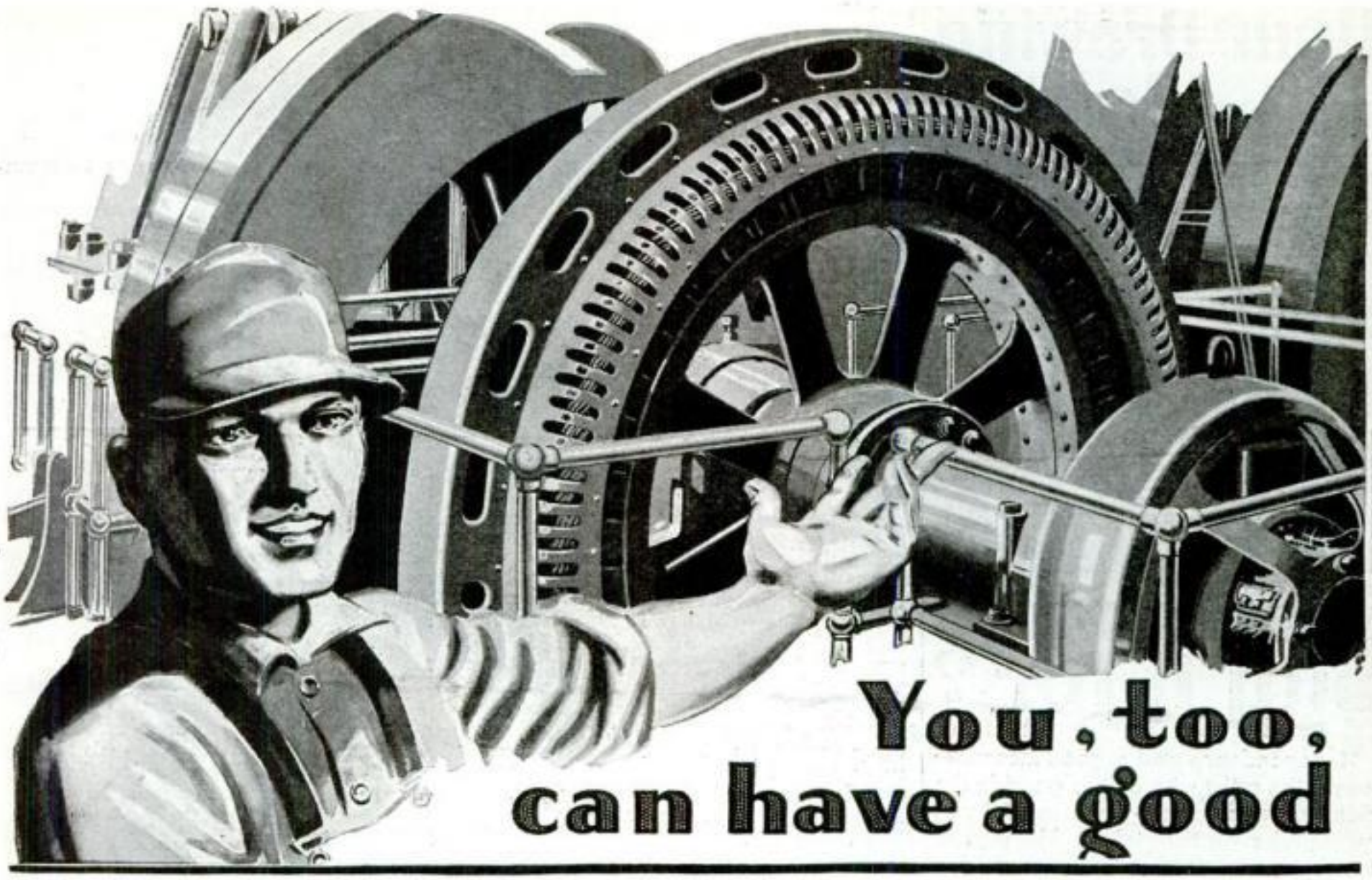
MR. MOK: What do you mean by carbohydrates?

DR. GREGORY: They are chemical compounds that consist of the right amount of carbon mixed with the proper quantity of water and oxygen. It is of these compounds that sugar and starch, the simplest forms of food, and cellulose are made. The outer skins of all cells consist of cellulose. But, and this is a very important point to remember, the combination of carbon with water and oxygen into carbohydrates cannot take place without the energy contained in sunlight.

MR. MOK: But you just spoke of the carbohydrates in our bloodstream. Now you say they cannot be formed without the energy in sunlight. Surely, sunlight cannot penetrate into our blood?

DR. GREGORY: No, it cannot. But the energy it contains gets there indirectly. As a matter of fact, we could not live without the sun. Life, including man, could never have appeared if it had not been for the sun. Without it, life could not survive for a moment. In other words, but for the sun, you and I would not be here.

MR. MOK: I understand that the sun is the source of all energy. How do we get this energy? *(Continued on page 138)*



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HOW MAN WAS CREATED

(Continued from page 136)

DR. GREGORY: The sun radiates in every direction. Anything can get in the way of the sun and be bombarded by its rays. But only certain things have the power to catch and store that energy.

MR. MOK: Haven't we?

DR. GREGORY: No, man does not possess that power. Neither does any other animal, large or small. But man and the animals do have the ability to steal it and store it. As I explained a while back, the tiny amoeba breathes as we do, or rather, as do the red corpuscles in our blood. It feeds itself also just as we do, by mixing the things it eats with the water it takes in, seasoned with a dash of digestive juices. But plants live in a different way.

MR. MOK: How do they live?

DR. GREGORY: They breathe the oxygen, as we do, but they manufacture their own food. They can do this because they have the power to catch and store the energy in sunlight. Under the action of the sun's rays, they build up the carbon, hydrogen and oxygen which they absorb from the soil, the water and the air into carbohydrates, or sugar, starches and cellulose. Because the plants can do this every tree, every flower, every vegetable and grain is really a small sugar factory.

MR. MOK: I don't see the connection between all this and human energy.

DR. GREGORY: Just a minute. While the plants are doing this, they release the oxygen. The carbohydrates they store up in the green part of their leaves, which is known as chlorophyll. The green portions of plants, in other words, are store houses of reserve chemical energy. It is this reserve we steal and store when we eat plants, or animals that have eaten plants.

MR. MOK: I understand. The human system produces energy by eating plants or animals that, in turn, have lived on plants.

DR. GREGORY: That is only partly correct. It is true that, every time you eat an apple, a salad, or a ham sandwich, you steal and store the solar energy that originally was caught and stored by plants. But it is not quite as simple as you think.

MR. MOK: Why not?

DR. GREGORY: You see, the reserve energy the plants store up in their green parts can be released only through reoxidation, or burning; that is, through combining the carbohydrates again with oxygen.

MR. MOK: How is that done?

DR. GREGORY: When we burn wood or coal in a fireplace or under the boiler of a steam engine, we combine the carbon in the coal or the carbohydrates in the wood—as you know, both coal and wood once were plants—with the oxygen from the air. That is exactly what we do when we breathe. We then combine, in our lungs, the oxygen from the air with the carbohydrates in our bloodstream from the plants which we have eaten.

MR. MOK: Then really we get our energy through breathing?

DR. GREGORY: No, we release it as a result of breathing, after acquiring it through eating and drinking.

MR. MOK: Now, you said that the fundamental mystery about the early life cells was that they could breathe.

DR. GREGORY: Yes, and I am sure you now understand why I said that. That is how they could use energy.

MR. MOK: But how could they survive when there was nothing for them to eat?

DR. GREGORY: They must have known how to make their own food, as the plants do. But the fact that there was not a single other living thing to do it for them, and which they could eat, is not the only reason that we believe they had the ability to manufacture their own food.

MR. MOK: What other evidence is there?

DR. GREGORY: To this day, there lives a tiny green water creature that has this power still. These creatures are called flagellates, because they have threadlike attachments shaped like whip-lashes, or *flagella* in Latin. They use these to propel themselves through the water.

MR. MOK: In other words, they are part-animal, part-plant?

DR. GREGORY: Yes. They are the descendants of the first branch on the family tree of life. After all the members of this new family had been part-animal, part-plant for a while, possibly millions of years, some settled down as plants, and some became animals.

MR. MOK: What was the reason for the split?

DR. GREGORY: Nobody knows. It is one of the great unsolved problems of science.

MR. MOK: What happened after that?

DR. GREGORY: Then began the great drama of life—the struggle for existence. For, you see, those that had become animals and had learned to move about, saw that the others, their tiny plant cousins, could make their own food. What was more natural and easy than to eat them? They did.

MR. MOK: But how did they evolve into other animal forms?

DR. GREGORY: These early little animals probably lived in puddles and pools, as they do today. As ages and ages went by, there was no longer room for all of them. So some of them were forced to crowd together in colonies and became primitive jelly fish. Others grew into small, wormlike creatures.

MR. MOK: So we are really descendants of worms?

DR. GREGORY: In a way, yes. The wormlike creatures, after perhaps hundreds of millions of years, evolved into air-breathing fishes. Armies and armies of fishes gradually choked the pools and streams.

MR. MOK: And then?

DR. GREGORY: In the end, some of them had to crawl out of the rivers onto the land or perish. They were the real ancestors of man.

MR. MOK: But the first men did not look like fishes, did they?

DR. GREGORY: Outwardly, they did not. Under the surface, they resembled them a good deal, and we still do. That is a different story. Let us take that up another time.

Do men look like fish? Is there any real resemblance between the face of a fish and your face? Basically, they are alike, and next month POPULAR SCIENCE MONTHLY *will give you the scientific version, as explained by Dr. Gregory, of how the face of fish evolved into the face of men. This is the best, simplest, and most understandable series of articles on the most interesting of scientific topics ever published anywhere. You cannot afford to miss a single one of them.*

LABORATORY rats and guinea pigs helped to prove that canned foods may be used as a sole source of vitamins A, B, and C, experimenters reported recently to the American Chemical Society. For five days the animals had their choice of five different kinds of canned foods. The experiments were continued until three generations of these "laboratory workers" had lived on seventy-four combinations of forty-nine kinds of canned foods. They are now in better health than animals fed on ordinary diets.

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THRILLS IN PILOTING AIR TAXIS

(Continued from page 43)

a mile. In such cases, the pilot alone makes the decision.

In preparation for every cross-country flight, the pilot plots his course and prepares his maps. I take greater care with this part of the preparation than many pilots. I circle every emergency landing field along the way so I can see them at a glance. I put large crosses at twenty-five-mile intervals along the line of flight so I can check up on my speed. And I lay off several lines so I have a choice of courses if bad weather closes in.

WHEN I fly from Long Island to Rochester, N. Y., for example, I lay off four possible courses. One is a straight line over the mountains, for use under ideal conditions. Another follows the Hudson to Poughkeepsie and then makes a bee line for Rochester. A third keeps on up the Hudson to Albany, then west along the Erie Canal. This is the "ugly weather route," avoiding the mountains and having clear landmarks all along the course. A fourth goes to Poughkeepsie, then diagonally across to the Albany-Rochester course, striking it above Otsego Lake. If the weather is clearing when I reach Poughkeepsie, I can cut across this way and save time.

Anyone who wants to become a cross-country pilot can learn much that will help later on by studying maps in spare time. He should lay off the courses of imaginary flights; familiarize himself with all the landmarks along the route; picture the shape of lakes, the curves of rivers, and the location of towns until he can see the whole course in his mind and can tell where he is on the map by seeing any one of these landmarks. Ordinary automobile maps are satisfactory for such practice.

During a flight, I keep fussing with the map. I like to play a little game with myself. I try to guess the name of every village I approach. I try to pick out from a distance the best possible fields to land in if the engine stops. I keep "going to school," trying to learn new things, all the time I am in the air. The pilot who sits at the stick like an unthinking robot never becomes a cross-country ace.

I learned one important lesson while "going to school in the air," about three years ago. It is to carry more than one map on a long flight. I was ferrying a Travel Air open cockpit biplane to Curtiss Field, Long Island, from Washington, D. C. The day was dark; the sky overcast.

North of Baltimore, I was holding the map high in order to get all the light possible on it when we hit a vicious down current. The ship plunged like a broncho. At the same instant, a gust whirled the map out of my hand. It sailed into the tree tops of a wood below. Fortunately, I was flying over a route I knew fairly well. If I had been above strange territory, or if a side wind had carried me off the course, that loss might have been serious. Now, I always carry a "spare."

KEEPING the course in a side wind is always a problem on a long flight. At thirty or forty mile intervals, I pick out two points, such as a hilltop and a steeple, which I know are on the line of the course. Then I head straight between them. If I am carried to one side of the second point, I know I am flying with a side wind and steer accordingly.

Another thing that must be taken into consideration on a long flight is the variation in readings of the compass. At Curtiss Field, about twenty miles from New York, the needle of the compass must be set to point eleven degrees west of north to point at true north.

At Philadelphia, it must be set at nine and a quarter degrees west; at St. Louis, five degrees east; and at Los Angeles, Calif., more than fifteen degrees east. These variations are due to the fact that the magnetic north, to which the needle of the compass points, does not coincide with true north. Unless a pilot allows for these differences as he goes along, his compass will lead him astray.

LAST summer, I hopped off from Indianapolis, Ind., in a fast Whirlwind-Stearman, flying east by compass. Above the clouds over Ohio, the instrument went haywire. I tried a trick an army officer had told me about during the war—flying with a wrist watch for a compass. To do this, you point the hour hand at the sun. Then an imaginary line halfway between the hour hand and the figure 12 points directly south. This information gives the pilot a fairly accurate idea of the direction in which he is flying. It has pulled many a flyer through emergencies.

Over Kansas and other states, pilots use the highways for compasses. They run directly north and south. In crossing one, I look over the side of the cockpit and note the angle at which the line of the fuselage cuts across the road. If this coincides with the angle from north at which the course across the map is laid, I know I am headed right. If it is greater, I swing to the north; if less, to the south.

At the end of the first half hour of flying, I always figure up my speed to know how far I can go with the fuel on board. My position on the map tells me how far I have gone in the half hour. The crosses at the twenty-five-mile intervals aid in computing the distance quickly. I get my speed in miles an hour by multiplying the distance covered by sixty and dividing by the time taken in minutes.

Sometimes I do this on a small pad which I carry in my pocket, sometimes in my head. A pilot knows the speed of his machine in calm air. But he never knows how many miles an hour it will cover on a given cross-country flight. Head winds may hold him back or tail winds may add to his speed.

NO EXPERIENCED pilot keeps on until his tanks are dry. He sits down at an emergency field and takes on gas when he sees he cannot make his destination with fuel to spare. A few days ago, a young pilot came in from Portland, Me., and thought he had enough fuel to reach Roosevelt Field. The engine stopped a mile from the field and he cracked up three hundred yards short of the boundary fence!

In fighting head winds, cross-country pilots sometimes fly low, as the gale increases with altitude. One flyer passing over northern Alabama in this fashion, a year ago, got the surprise of his life. His engine cut out and he came down for a dead-stick landing in a large cotton field with a hedge at the far end. Overshooting the field, he hopped the hedge expecting to sit down in another field on the other side. Instead, he found himself over a wild ravine a hundred feet deep. Coming in low, he hadn't seen it. He cracked up in an oak tree but escaped without serious injury.

On cross-country work a pilot fights many opponents. He must watch the wind, the weather, the plane, the engine, his course and the character of the ground. Yet, mileage equal to approximately half a dozen trips around the earth is covered for every serious accident in the flying taxis.

MOVIE NEW EYE OF MICROSCOPE

(Continued from page 27)

camera Rife has built a twenty-one-jewel, high grade watch movement that automatically makes pictures at any desired interval—from the usual sixteen or eighteen a second to one every five hours.

THUS he has been able to record on one film the complete life story of the hookworm, from the hatching of the egg to the full development of the serpentlike parasite. "I set the camera controls," Rife explained, "and placed one egg of the hookworm in the center of the stage. When I returned, seventy-two hours later, I had a complete film record of the parasite." The film takes only a few minutes to run off, but a research worker bending over his microscope would spend three days and nights, an all but impossible task, to see the same things happen.

Either as he makes the film or afterward, Rife records a lecture to accompany it upon a sound strip synchronized with the pictures. He explains, too, the effect of special treatments administered to the germs under the camera's eye, such as doping them with drugs, or testing the effect of heat and cold.

Weighing germs and timing the speed of their movement are some of Rife's feats in microscope land. He showed me a quartz slide bearing several hundred typhus germs, invisible to the eye, and then slipped it beneath the microscope. I peered into the eyepiece and saw a score of small black objects which appeared about an eighth of an inch long. Waving wildly from each were from one to eight black filaments. Hither and yon they dashed so rapidly that the eye could hardly follow them.

"If a man could move proportionately fast, he could travel on his own feet more than 500 miles an hour," Rife said. He timed them by etching measured lines on the slide and noting how many lines they crossed in a fixed time.

"We have weighed them on extremely delicate balances," Rife added. "The weight of these disease germs averages one-184-trillionth part of an ounce."

HOW various rays affect the lives and activities of disease germs was another thing that Rife wanted to find out. One day he rigged up an electric discharge tube, an instrument of which the X-ray and cathode ray tubes of laboratories are special forms, and shot through it the comparatively high current of sixty-four milliamperes. He obtained a strange ray that casts a greenish glow on the surrounding atmosphere, and of a sort beyond the usual range of X-rays. It penetrates air so easily that it may be detected at great distances from the tube. Rife devised a liquid screen of salt solution and acid to protect his hands against injury from the ray.

While X-rays had no effect on lockjaw germs, and ultra-violet or invisible light rays merely halted their development, Rife discovered that the green ray would destroy the microbes. Now he is making a movie of that operation.

Rife has devised a magnetic compass so delicate that it can be used to study the electricity and magnetism in living germs. He suggests that if the electrical make-up of certain dangerous germs is learned, it may some day be possible to destroy them in the human body by applying small doses of electricity. In no way, however, Rife makes clear, does this idea uphold the claims of medical fakers that they can cure disease by applying electrical "vibrations" to the body of a patient.

BUILDER BUILDS HIS OWN HOUSE

(Continued from page 75)

having at the same time all of the practicability of highly glazed tile.

Over the washstand, instead of the old-time medicine cabinet, is an etched mirror. Across on the other side of the room is a built-in cabinet of generous size, where all essential bathroom supplies may be kept. The toilet is of the new flush valve type. No water storage tank is necessary, there being sufficient force from the water pipe pressure. It is, of course, necessary to have two-inch pipe lines in order to obtain enough pressure, and this adds to the cost of installation; however, in plumbing fixtures the latest and best is, as a rule, genuine economy in the long run.

LAST of the rooms is the library. In my business I have many callers, and this arrangement is ideal, as it would be for a doctor, lawyer, real estate man, architect, contractor, insurance man, public official, or music teacher. As you will see from the plan, callers may be ushered from the vestibule directly into the library, while members of the family have entrance to the room from the service hall without going through living or dining rooms.

There are several features of interest in the basement. We have a hot water heating system with gas boiler. We put this system in because it is my personal preference as the best heating system available today. In a new building it costs less than an oil heating plant to install, although here, where natural gas is not available, gas fuel will cost more than oil.

We feel, however, that this is one of the places where we can be permitted to indulge ourselves a little to provide the best for our own comfort. Besides, in the long run, it will not be so much more expensive, as gas is undoubtedly the cleanest form of fuel now available, and we expect to save considerably on our rug and drape cleaning and redecorating expenditures.

Over in the corner is the fruit cellar, entirely bricked in. This, of course, provides an ideal place for fruit storage. Then here is another strictly modern feature of great convenience, as well as decided operating economy. It is a combination garbage incinerator and hot water heater. The garbage is simply thrown in at any time. A pilot light, burning continuously, automatically starts the gas burner and sets fire to the garbage whenever water is drawn from a faucet.

Then there is a clothes chute made large enough to be serviceable. It's a simple thing costing only a trifle, but it's surprising how many clothes chutes are too small. It measures about two feet by two and one-half feet. A bottom board retains the clothes in the chute until ready for laundering, when they may be taken out through a large door provided for the purpose, as shown in the illustration. You will note, also, that the chute is constructed of slats, which permit free circulation of air, and keeps the clothes from mildewing. Also note the large soap cabinet underneath, where all laundry accessories may be kept.

THERE'S another point about the basement to which I should like to call attention. That is, the drain is in the right place, and the floor is properly pitched to the drain. You might think this always ought to be done. So it had, but I've seen lots of floors in my day, and you'd be surprised how many were improperly drained.

I have known of cases where people have bought houses and found that the drain was under the furnace. The cement floor man didn't give any thought to where the heating plant was going to be located and, of course, the heating plant must be in a suitable place for heating efficiency. The drain should be near the stationary tubs, and the floor properly pitched to this point from all directions.

Along the inside basement wall are the controls of the underground lawn sprinkling system. In putting in an underground system, it should be nearest the surface of the ground at the farthest point away in the yard, and proper pitch provided toward a drain cock, so that the pipe line may be thoroughly drained for the winter. Usually the piping is simply laid in the trench, without any attempt whatever made to level the bottom of the trench.

In our installation all piping was leveled with a straightedge and plumb, and the bottom of the trench graded to a perfectly even foundation, on which the piping rests. Where this is not done, the pipe is liable to sag at the low spots in the trench, allowing water to stand in these places instead of completely draining out. Water standing in the sags is, of course, likely to freeze and burst the pipe. We used seamless copper tubing, in one piece without joints, insuring a long wearing installation.

ONE of the things in building construction, unseen in the finished dwelling, which is very much of a hobby of mine is heat insulation.

Proper insulation is vital, because it is difficult to remedy if unsatisfactory. It greatly affects the comfort of the occupants, in addition to its important economic fuel saving virtue. The old system is to rough up a house and then take a few rolls of paper and tack it up hit or miss, to keep out the wind. I believe, however, that within a few years practically no dwelling houses will be put up without scientific insulation in the walls and the roof.

As you know, modern heat insulation, while of different types and forms, essentially acts as a blanket enveloping the house, keeping the heat in in winter and out in summer. I have used one of the boardlike types of insulating material, although, as a matter of fact, nearly all of the standard types are now efficient. The main thing is a thorough job of installation, with tight corners and joints. In addition to the insulation of outside walls, all ceilings are double insulated, which, I believe, is a most important factor in keeping a house warm in winter and cool in summer.

I would like to point out that while some of the features of this house have cost more to get the best, on the other hand, we have been able to obtain the newest types which cost less than those formerly in general use. Anyone who is building a house can accomplish a great deal along this line by a careful study of various modern building methods.

HOSPITAL HAS AIR LOCK TO TREAT "BENDS"

AN AIR lock for treating divers and caisson men soon will be installed in a New York City hospital. These men, who work under high air pressure far down below the city's streets, suffer from an ailment known as the "bends." It attacks them if they come too rapidly from their high-pressure working conditions into the atmosphere, doubling them up in great agony. The only treatment that will relieve them is to put them under pressure again and bring them out slowly. The New York air lock is believed to be the first of its kind ever installed in a hospital.

X-RAY NEW WATCHDOG OF SAFETY

(Continued from page 56)

tires, connecting rods, and other important parts are thus detected.

Giant transport planes now carry as many as twenty or thirty passengers at one time. Here safety depends on the soundness of piston and cylinder castings, connecting rods, crank shafts, and fuselage welds. In many planes such parts must be found perfect by X-ray inspection before they can be used.

But the work of X-rays comes closer to the average man than the examples just mentioned. The traveler by train and plane is not the only one who must be protected from danger. Suppose you are driving in a motor car and suddenly see danger ahead. You yank on the emergency brake as hard as you can. Have you ever stopped to consider what might happen if the rods broke at that critical instant? Or have you ever thought of the consequences of a broken steering-gear rod while you were driving at forty miles an hour?

Here again, in your car, the X-ray sits at your elbow, seeing that your course is made as safe as possible. A large automobile manufacturing firm has installed a complete X-ray inspection laboratory, in which are examined important parts of the cars.

Engineers of another large firm of motor car manufacturers recently had all the welds on brakes and steering gear rods of a new model they were developing X-rayed.

ONE of the largest boiler manufacturing concerns in the world, with plants both in this country and Europe, realizing the importance of this method of inspection, recently installed its own X-ray plant. In constructing the boilers for new cruisers built for the United States Navy, they welded seams instead of riveting them, the first time this had been done in marine work. The Navy Department, however, insisted upon an X-ray examination of the seams before the boilers were put in service.

"But those are all instances where X-rays protect life and property in engineering fields. Here is a sample of how they come into the average home," said Isenburger, handing me an aluminum frying pan. It looked like a good one, but I changed my mind when he showed me an X-ray photograph of the bottom of the pan. This revealed a cluster of white spots on one side, indicating that the metal had numerous holes in it.

All sorts of small parts, failure of which would be no risk to the user, are X-rayed. In the case of these the idea is to protect the buyer from inferior articles and to assure manufacturers that they are selling products that will not break or wear out easily. As a sample of such inspection I was shown an X-ray photo of an electric flatiron, which proved that its heating element was sound.

Up to the present X-rays have not succeeded in penetrating to a greater depth than four and one half inches of steel. Since pressures used in modern engineering practice are steadily becoming higher, requiring the use of heavier parts, this method of inspection will soon be inadequate. In order to probe into the secrets of thicker metal parts, engineers at the Naval Research Laboratory at Anacostia, D. C., have perfected a method of taking "shadow pictures" by radium's gamma rays.

By this method a small capsule of radium, the size of a twenty-two caliber bullet, and the film is all the equipment needed to peer through as much as ten inches of steel. Its simplicity makes it easy to move, so it can be used in a greater variety of locations than the bulky X-ray apparatus. Naval engineers have used this method of inspection successfully on gun forgings and armor plate.

EXPLODING DUST COSTLY

(Continued from page 29)

ticles, a roomful burning in a single deadly flash. The sudden expansion of hot air and gases builds up pressure and produces the explosion.

Before dust can explode, two conditions have to be met. The combustible bits must be properly distributed through the air, and there must be a fire of some sort to touch them off. This need not, necessarily, be an open flame. One severe aluminum blast in the East started from a spark flying from a sledge hammer wielded by a workman.

Another explosion that wrecked a Philadelphia, Pa., box factory began when a bolt, carried into a grinding machine, sent off a shower of sparks. But the most unusual ignition source of all started a factory-wrecking explosion in England. During a severe thunderstorm, lightning struck close by. Electric sparks, leaping through the aluminum-dust-filled factory, touched off the charge.

FREQUENTLY, the source of a blast is never known. Many times, every eye witness to its beginning is killed and the factory is demolished.

One of the few cases on record where a worker saw a dust explosion and lived to tell the story occurred a few years ago in a mid-western starch factory. A new night man, not fully realizing the dangers of dust, walked into the plant carrying a lighted lantern. He described what he saw as follows:

"The starch particles began circling around and around the lantern. Then the air all about the light took fire." He was knocked unconscious, but miraculously escaped.

In factories where the dust explosion hazard is present, precautions are taken to eliminate every possible source of sparks and fire. Metal brushes remove static electricity from moving belts; magnetic separators catch pieces of metal before they reach machines or steel conveyors; electrical switches, likely to give off sparks, are installed outside the working rooms.

Strict rules against smoking, or even carrying matches, in dusty plants are enforced. Nonsparking tools, of special alloy, are frequently used, and double globes are fitted to electric lights to prevent the dust from coming in contact with the heated glass of the incandescent lamp. One organization recently spent $30,000 installing equipment that would make a single factory explosion-proof as well as fireproof.

OFTEN the blast originates from a wholly unexpected source. In 1924, in Pekin, Ill., one of the worst starch explosions in history was touched off when a hot bearing ignited floating particles around it. Paradoxically enough, a mill in the state of Washington was wrecked because a bearing was rebabbitted to keep it from overheating!

While the workman on this job was using his plumber's torch, a laborer thoughtlessly began sweeping the floor. The cloud of fine dust he raised burst into a sheet of livid flame, partially destroying the mill.

In 1888, flaming particles of oatmeal dust demolished a huge mill in a midnight blast at Chicago. For blocks around, people were thrown from their beds. Another outburst of destructive dust occurred at Litchfield, Ill., in 1893. A flour mill blew up like a giant bomb and practically every house in the village of 8,000 was wrecked.

Other dusts, in rapid succession, joined those on the dangerous list. Candy, in finely-powdered form, became recognized as a high explosive when cocoa particles shattered a half-million-dollar chocolate factory in Burlington, Vt.

Phonograph record dust exploded in a Bridgeport, Conn., factory; and in a western tannery, specks of leather tore down the walls when they were ignited by a freak blaze which was caused by the friction of pieces of bark rubbing together in a grinding machine.

In recent years, the hazard of dust explosions has increased rapidly due to new manufacturing methods. Wood flour, highly explosive pulverized sawdust, is used widely in manufacturing toothpaste tube tops and other synthetic resin products. Powdered coal, so fine it can be shot through a nozzle and burned like liquid fuel, has been adopted for industrial heating, bringing to many factories a new variety of dangerous dust.

So serious has the menace of exploding particles become that a special branch of the Bureau of Chemistry of the U. S. Department of Agriculture has been formed to battle it. Under the direction of David J. Price, a staff of "dust detectives" follow the destructive activities of the explosive motes from coast to coast, and in their Washington laboratories study the habits and peculiarities of the floating particles.

EACH kind of dust, Price has found, has a "personality" of its own. For instance, sulphur particles will take fire more easily than starch particles, but produce only half the volume of gas and consequently explode with much less violence.

In one of the research laboratories of the dust explosion unit, delicate instruments recorded the pressures developed by pulverized matter of various kinds when it was set off within containers. Crushed Pittsburgh coal was tested first. The pressure these burning particles produced was ranked 100.

Compared to this Pittsburgh yardstick, the experimenters found that the explosive violence of grain dust ranked eighty-five, sugar dust ninety, sulphur dust ninety-five, starch dust 102, and aluminum bronze dust the highest of all, 115.

A teaspoonful of grain dust, their tests revealed, caused an explosion severe enough to rattle the windows of a large room. The explosive force of only seven pounds of starch would be sufficient to hurl a huge railway locomotive above an eight-story buildi !

The most violent, and also the most temperamental, of all the dusts is aluminum. It is notoriously quick on the trigger. It is possible for the human eye to follow the advance of flames through a cloud of grain dust, but aluminum dust detonates in one lightning-bolt flash. Again, exploding grain dust follows the path of least resistance, while flaming aluminum particles seem to charge blindly in whatever direction the first impulse sends them. In one Pennsylvania factory, for instance, a small cloud of aluminum dust at one side of the room ignited and blew a hole through a solid brick wall under a window without even cracking the glass in the sash above!

THE records compiled by the investigators show that the three aces among exploding dusts are those of grain, starch, and wood. Grain particles have destroyed greatest amount of property, starch powder has snuffed out the most lives, and wood dust has been the most frequent cause of explosions in recent years.

Not long ago, one of these frequent wood dust blasts grew out of a curious train of events. A helper in an Albany, Ind., woodworking plant discovered an accumulation of oil and dust on a hot bearing dripping fire and sparks into a heap of fine sawdust. In his excitement, he dashed a pail of water on the smoldering pile, throwing it up into an explosive cloud *(Continued on page 146)*

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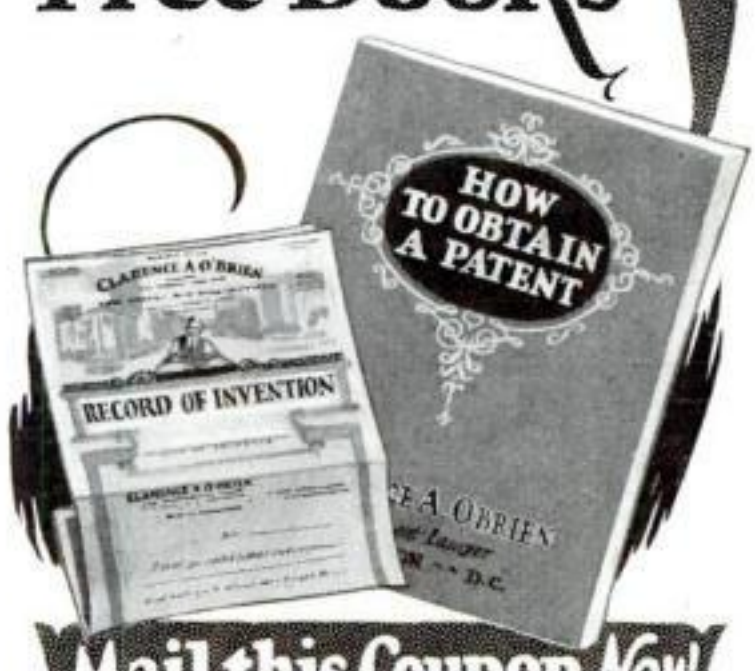

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EXPLODING DUST COSTLY

(Continued from page 144)

that when ignited destroyed the entire plant.

How much dust is needed in the air for the mixture to explode? That was one of the first questions the dust explosion unit sought to answer. Every motorist knows that by adjusting the carburetor he can produce a mixture so lean that it will not explode in the cylinders. Similarly, if the air in a factory contains only a slight amount of combustible dust, it will not ignite.

TO FIND the dividing line between a dangerous dust mixture and a harmless one, the Washington scientists set off hundreds of minute charges within special glass containers. Gradually they reduced the amount of dust until they had a mixture just below the danger line. For example, seven ounces of starch in a thousand cubic feet of air, they found, is the lower limit of explosiveness for that dust. Factories where numerous vents, dust-collecting devices, and dust-tight machines keep the floating particles below this limit are free from the menace of explosions.

Another test made by the laboratory workers showed that when the oxygen content of the air in a container was reduced below twelve percent, explosions of dust never took place. When it was raised to seventeen percent, the dust readily ignited. The usual oxygen content of the atmosphere is something over twenty percent.

This discovery suggested a way to conquer explosive dust hazard in many industries. By introducing inert gases, which will not support combustion, into machines where sparks might occur, the oxygen content can be reduced below the danger line. In several factories, flue gas, piped from the boiler room and costing nothing, has been used for this purpose.

In other plants, tanks of compressed carbon dioxide are installed with pipes leading to all likely sources of ignition. This gas attack upon dust particles has proved one of the most important weapons so far devised.

A common characteristic of many dusts, demonstrated in the laboratory not long ago, gave a clue to an old riddle. In 1907, a starch factory at Oswego, N. Y., exploded with great violence. The building was demolished. But a puzzling feature of the blast was that the brick walls had been sucked in instead of blown out by the terrific detonation.

LATER, at Port Colborne, Canada, when a grain elevator was shattered by exploding dust, glass from a broken window was picked up inside the building instead of outside. The laboratory tests showed that starch and grain dusts both produce high temperatures that fall off rapidly. This often creates a vacuum within the structure and pressure from without crushes in the walls.

Another mystery, noted in several dust blasts, remains unsolved. Debris from an exploding starch factory in Cedar Rapids, Iowa, in 1919, was thrown two and a half miles away when flaming motes hurled solid sheets of flame 500 feet into the air. People seventy miles off heard the roar of the ignited dust. Yet, a man working in the boiler room did not hear a sound.

Sometimes, the experimenters have found, the slightest spark will set off a dust blast. At other times, when conditions seem ripe for a terrific detonation, nothing happens.

On the day of the Chicago grain elevator explosion, half a dozen smoldering fires were discovered in the conveyors during the day. Why had a later spark started things where these fires had failed?

Using the powerful microscopes of the laboratory, the *(Continued on page 147)*

EXPLODING DUST COSTLY

(Continued from page 146)

dust detectives found the probable answer. When dust is so fine that it takes 6,000 grains to reach across a silver dime, it is highly explosive. But when the grains are so large that 600 will bridge the coin, it is comparatively safe. Often the minute particles of the finer dusts stick together in clumps. So long as they remain in clusters, they behave like larger particles and are harmless. But an electric shock or a sudden change in temperature or humidity may cause them to break up. Thus, at one instant, dusty atmosphere may be clumped and harmless; the next, finely divided and aerial dynamite.

THE same laboratory microscopes also explained a sudden increase in rubber dust explosions in the United States. With the introduction of ball grinding mills in place of roller mills, the number of blasts in this industry jumped upward. The dust explosion unit investigated. It found that practically all the particles coming from the roller mills were coarser than one thousandth of an inch in diameter, while those from the ball mills were mostly under one ten-thousandth of an inch, and consequently much more explosive.

In their work of assembling a rogues' gallery of dangerous dusts, Price and his associates have been able to suggest important safety measures. The latest factories are constructed with all possible window space. In a blast, the glass is broken out, relieving pressure within. Swinging doors and windows, arranged so an explosion will throw them outward, are other safety valves designed for factory use.

In a steel shed on the outskirts of Washington, these swinging valves were tested with scores of experimental blasts. They proved that enough cornstarch to blow the building to pieces, if no outlets were provided, could be set off without harm when windows and doors could swing open.

Additional tests were made to determine the venting area required for different dusts. Grain particles, for example, need one square foot for every eighty-seven cubic feet of air space in a building. Aluminum dust, on the other hand, demands one square foot for every fifteen cubic feet— nearly six times as much.

In spite of these recent studies, there are many unexplored areas in the world of dust. No one can yet predict accurately what the menacing motes will do under all conditions. The infinitesimal specks continue to explode at intervals, unleashing a tremendous power that takes its toll in lives and property.

Why, it is often asked, is not this power harnessed to run our engines? Why not make use of this dangerous waste product as a cheap fuel to replace gasoline?

MANY attempts in this direction have been made. In fact, the famous Diesel engine was originally designed as a dust-using power plant. At the last minute, the inventor switched to heavy fuel oil in place of the crushed coal which he had intended to explode within the cylinders.

In Germany, several experimental dust engines have been built. One, using crushed brown coal, has been in operation for some time. Another, utilizing grain dust, is said to have run an elevator there last summer.

In Washington, several years ago, the Department of Agriculture experimenters demonstrated the explosive force of dust by running an ordinary automobile engine on cornstarch. The motor turned over a few times and then blew a cylinder head through the roof of the testing shed. In time of war, Price recently declared, dust might come into extensive use as a fuel, even for airplanes.

TONY FOKKER AND THE WORLD WAR

(Continued from page 26)

Unlike the mild Boelcke or the brilliant Immelmann, Richthofen cared nothing for the technical details of the planes he flew. He took up aviation only because the cavalry to which he was attached had no place in modern warfare. At the flying school, he showed little natural ability. He crashed on his first solo. But he flew with his brains, learned to be a pilot by sheer will power, and mastered his unruly ship as he would master a vicious horse.

Richthofen was cold, calm, ambitious. He was a man hunter who carried his grim profession almost to perfection. He planned every detail of the attack, figured out every possible move of the enemy, and in the heat of battle functioned with the precision of a machine gun.

AT THE time of his death, this grim cavalryman of the sky was credited officially with eighty victories. He never shot until he was sure. Sometimes he returned after bringing down two enemy ships with less than thirty bullets gone.

He conquered nearly sixty planes before he met his first defeat. A stray machine gun bullet, fired by an excited observer more than 300 yards away, struck him on the head, laying bare the white skull bone, leaving him paralyzed and blind. His arms hung limply, his legs flopped loosely beyond his control, while his machine was plunging through space at two miles a mihute. His escape from death is one of the most amazing on record.

"In my falling plane," says his report of the accident, "I begin to regain power over my arms and legs. Mechanically, I cut off the motor. . . . But what good does that do? One cannot fly without sight. I force my eyes open—tear off my goggles—but even then I cannot see the sun. I am totally blind. I concentrate all my energy. I say to myself: 'I must see . . . I must . . . I must see!'

"I had fallen at least 6,000 feet . . . Suddenly, I can discern small black and white spots . . . I look into the sun. It seems as though I were looking through thick black goggles . . . I notice my strength is leaving. . . . I must land at once . . . everything is turning black again. I land . . . I tear down a few telephone wires . . . I tumble out of the machine and cannot rise again . . ."

AFTER that nightmare in the sky, Richthofen was never again quite the same. The finger of death had touched him. An enemy's bullet had found him. Although he rode again at the head of his red cavalcade and downed other Allied ships, the realization that he was not invincible slowed him up. A comparatively unknown Canadian, diving out of the sun over the Western Front, shot him down in a hot dog-fight in April, 1918.

Sometime after 1916, agents of Great Britain made an offer of $10,000,000 if he would return to Holland and build planes for the Allies. Fokker never heard of the message until after the war.

Rival plane makers, especially the powerful Albatros company, made the most of this evidence to discredit him at headquarters. He sensed a sudden coolness toward him, an air of suspicion. The best engines were diverted to other factories. Finally, he was told to use all his resources in making Albatros training planes, an order that would keep his factory marking time while other designers perfected new fighting ships.

Disgusted, he asked permission to return to his home in Holland. This increased the suspicion at headquarters and he was ordered to become a German citizen at once. He refused. Then by special, and illegal, army decree, he was declared a German citizen and given his choice of building whatever planes he was told to build or of going to the front line trenches.

IT IS under conditions such as these that this fighting Dutchman battles hardest. He called on his flying friends at the front to help him. They brought pressure to bear on headquarters to permit a committee of aces to choose their own planes in open competition. When this was granted, Fokker turned his factory over to a trained supervisor and worked night and day building his secret entry, which was later known as the famous D-7.

It was finished just in time for one short trial hop before it had to be rushed by truck to the Johannisthal air field.

Practically all the first day, Fokker flew his new craft, learning what it would do. He looped, twisted, dove, spun. Never had he piloted a plane so sensitive to the controls. But the longer he flew it, the heavier his heart became. He realized what he had built was a "suicide plane." On the slightest provocation, the delicate ship plunged into a deadly tail spin. He knew that if one of the Front pilots, unused to the machine, took it up the next day, he would be killed.

Assuming a carefree manner, he landed, rolled his ship into its hangar, and left the field. At his hotel, he wired for two of his best welders to come from Schwerin. He believed the trouble with the plane was a lack of side area at the rear of the fuselage. A little after dark, the welders arrived. Stealing into the dim, cavernous depths of the big hangar, they labored like gnomes under the violet glare of oxy-acetylene torches, cutting through the fuselage to weld in another bay of two feet and enlarge the fin in equal ratio.

Working all night, they finally patched the fabric so smoothly that nothing appeared to have been done. Tired as he was, Fokker rolled the plane into the morning sunshine and took it up for a test flight. It behaved perfectly. That day, the D-7 carried off the competition on all counts and before long over the Western front it was writing aerial history.

THAT decisive victory crushed the enemies of the Dutch designer. He was given an unlimited supply of the best motors and the whole Albatros plant was ordered to produce only Fokker planes, paying him a large royalty. Fokker's supremacy as a designer was never again seriously challenged during the remainder of the war.

As hostilities neared their close, life became grimmer in beleaguered Germany. Food was worth its weight in gold at Schwerin. Pilots would hop off ostensibly for altitude tests and not return until the next day, having landed near a farmhouse where they were assured of sufficient food. Often they came back with the cockpit filled with produce.

The war ended with Fokker ships still supreme in the German sky. Young Tony had achieved his ambition. He had piled up enough capital to continue building planes on a big commercial scale. Then revolution engulfed the country. The value of German money plunged lower and lower. The fighting Dutchman was in the midst of one of the greatest battles he ever fought. Escaping from Schwerin by night aboard a freight train, he began a dramatic struggle to save his capital, an almost single-handed battle against tremendous odds.

Next Month: How Fokker outwitted his German enemies, how he came to America, and how he built record-making planes for the aces of peace. Watch for it. In the July issue, on sale June 1.

BRAIN TESTS KEEP CROOKS IN LINE

(Continued from page 57)

ple assault and battery are of this type.

To determine this quality, the psychologist watches the prisoners closely while they are undergoing a test. Suppose four men are given the mirror test. All four find it difficult. One will get angry and throw down his pencil. The second has an alibi, and claims his coat cuff gets in the way. The third laughs, and says he cannot draw for laughing. The fourth grits his teeth and does the best he can.

IF THESE four men are given paroles three of them, experience has shown, probably will be back in jail sooner or later—the man who got angry, the one with the alibi, and the one who resorted to laughter. They are the least emotionally stable. The records support the conclusions of the psychologists.

Scores of learning and memory tests, ranging from word checking to fitting pegs in a ring filled with various-sized holes, are used by Dr. Holsopple and his associates to test intelligence. They have found that the old theory that all criminals are feeble-minded is a fallacy. Many are, but others are above the average in intelligence, though the general level is low.

In all, between 300 and 400 tests are used as a basis for the investigations. Every New Jersey prisoner, on entering an institution, receives a thorough psychological examination. Later, other tests are made to determine suitability for parole, transfer, or change of work. In juvenile institutions, additional examinations are made every few months to note changes.

A large proportion of all juvenile offenders, according to Dr. Holsopple, get into trouble through a single mental trait—suggestibility; that is, being easily led by others.

IN CHECKING on the suggestibility of an inmate it is necessary only for the psychologist to place his fingers lightly on the wrist of the prisoner, whose eyes are closed, and say: "I am pressing harder. Can you feel it?" or: "Now I am lessening the pressure. Notice it?" Sometimes the investigator does as he says. At other times he does the opposite, or presses with equal force throughout the test. Those who think they feel whatever is suggested to them are likely to act uncritically upon other suggestions.

The investigation has shown one characteristic which frequently sets the criminal off from others is the inability to understand fine points of difference in situations that appear the same. For example, a boy not long ago was sentenced to Annandale Reformatory. For a few years, he had been employed as a truck driver.

One evening, a friend asked him to move some furniture for him. On several occasions, his employer had allowed him to take the truck to get coal for himself. He saw no difference in the situations, and when his friend gave him two dollars he kept it and said nothing about it.

Later, he did the same thing again. He was found out, arrested, and sentenced. When the psychologists talked to him he was at a loss to understand the difference between hauling coal for himself with his boss's consent and hauling furniture for a friend and keeping the change.

In testing prisoners to discover their ability to note such differences, the psychologist first "sizes them up" while talking to them about their past experiences. In addition he may show them a series of various-shaped simple designs. Those who can distinguish quickly between shapes and designs, Dr. Holsopple says, usually also can detect shades of difference in closely-related situations.

WIRES CATCH BIRDS' SECRETS

(Continued from page 23)

according to the hotness of the day. Temperature of the eggs during incubation ranges from ninety to 100 degrees depending upon whether the mother bird is sitting on them or not.

To learn facts about the body heat of birds, Dr. S. Charles Kendeigh, long an associate at the bird research laboratory, has taken their temperatures approximately 20,000 times in the past four years. He has found that the body temperature of a healthy specimen of perching song bird may shift between 104 and 112 degrees F., in a short time. Within a few minutes, a change of two or three degrees may occur. Activity quickly raises temperature. Birds, it has been discovered, can stand considerable lowering of body heat without permanent discomfort. But a rise to 115 degrees F. is fatal.

ONE day, Baldwin was talking to an old college friend, Dr. W. R. P. Emerson, of Boston, an authority on child nutrition and the originator of child feeding methods adopted in many cities. When Baldwin told him of his study of bird temperatures, the doctor became enthusiastic.

"I can use your results in my work," he said. "Experiments can be made with birds that cannot be performed with children because the body temperatures of birds can be above and below the points that would be fatal to a child. Also, the bird temperatures can be varied rapidly. Perhaps birds can also be used in studying the effects of fatigue, rage, fear, and other conditions on body temperature."

A second mechanical watcher which Baldwin installed on his farm was called, at first, a "wrenograph" because it was designed to give further information about a family of saucy little wrens close to the farmhouse. Later, it was used for all kinds of birds and christened the "itograph."

The initial thermocouple apparatus had not been able to record visits of adult birds to the nests for feeding the young. Such visits rarely lasted more than thirty seconds, not sufficient to cause a measurable change in temperature. So Dr. Kendeigh set to work to devise an automatic recorder of such visits.

At the nest he placed two perches, one outside the bird house, the other inside. When the bird was away, the two perches, mounted as though they were the ends of a miniature seesaw, were held horizontal by springs. When one of the parent birds alighted on the outer perch, its weight caused that end to swing down. This closed an electrical contact.

BACK in the laboratory, a recording pen swung to one side, indicating on a moving paper that the bird had depressed the outer perch. When the inside perch was occupied, the pen swung the other way. Always the pen returns slowly to neutral position when the perch is level, so the record indicated which perch was used first; that is, whether the bird was entering or leaving the house. Also, the exact time of each movement was indicated on the graph.

Thus, day and night, the itograph is able to keep on the job—compiling its record of interesting information, keeping tab on how often the young are fed, when the mother bird departs, when she returns, and how long she is gone.

One unique record was produced by a father bird tearing the lining from a nest to carry it to a new homesite. So frequently did he enter and leave the bird house that the graph looked like a picket fence.

Probably the most difficult piece of "inside information" that Baldwin obtained was a record of the heartbeats of wild birds under normal surroundings. It would be easy to capture a bird and count the flutterings of its heart. But that would tell nothing about its normal rate of beating. What Baldwin wanted was a device that would enable him to hear the beating of a bird's heart from a distance. Dr. Sawyer, of the Brush Laboratories, who had suggested the thermocouples, was consulted.

HE FIRST experimented with a caged canary. Placing a carbon microphone near by, he hooked this instrument to an amplifier that fed into a radio loudspeaker. Then he listened. Sound came out of the speaker but most of it was microphone hissing. The scheme was unsatisfactory. So Dr. Sawyer attacked the problem from another angle.

He substituted piezo-electric crystals for carbon grains in the microphone. These mysterious crystalline forms produce electrical currents, often of considerable magnitude, when subjected to pressure or vibration. When this apparatus was placed near the perch where the canary was hopping about, the regular pounding of its heart could be heard—but very faintly.

Finally, it was the canary itself that solved the problem. One day, it refused to hop on its perch. Instead, it selected the wooden rod that connected the piezo-electric crystal to a paper cone intended to catch the sound. Immediately from the speaker issued the sound of the heartbeats, distinct and loud. By standing on the rod attached to the crystal, the bird had established a direct sound path from its heart through the crystal and amplifier to the loudspeaker.

BY SETTING up the crystal near the nest of a wild bird so that its wooden pick-up device was used as a perch, the heartbeats of the bird as it returned from a flight could be counted. Also, another count could be made when the same bird left the nest after resting. In the laboratory office, it was possible to connect the amplifier to a device that automatically kept a permanent record. The crystal microphone arrangement was found to be so sensitive that the noises of breathing and digestion could be studied as well as heartbeats.

Many people believe that moving the eggs or touching the nests of wild birds will cause them to leave the vicinity. When Baldwin began his work, he maintained that one of the first rules of success in studying birds is to disturb them as little as possible. Now, however, after years of experimenting, he has found that when birds are familiar with the person who does the work, they are not frightened away even though the eggs and nests are handled constantly.

In fact, hundreds of eggs, which were marked when first found, are carried to the laboratory and carefully weighed by the research assistants. If you were to visit Hillcrest Farm, you might observe Dr. Kendeigh, for example, nonchalantly thrusting thermometers down the throats of young wrens while the mother bird stands patiently by, waiting until he is through.

At Hillcrest Farm, Baldwin sometimes spends sixteen hours a day watching his feathered charges and examining the elaborate equipment that has turned his hobby into a research experiment of far-reaching value. He has become a scientific Pepys of the birds. And his accumulating records are marking a steady advance in widening our knowledge of these interesting neighbors.

WHY YOUR CAR NEEDS INSURANCE

(Continued from page 82)

old car that I couldn't sell for six hundred bucks!"

"There you go figuring cars again," said Gus. "Auto liability isn't to protect your car. It's to protect everything else you own. It doesn't make any difference whether you drive some old crock worth less than a hundred dollars or a brand-new bus in the two-thousand-dollar class. What you're trying to do with liability insurance is protect yourself, not your car. Even if you only own a house worth five thousand dollars or less or a little private business you need plenty of protection. No matter how little you've got, you'll lose it if you get into an accident and the judgment is bigger than your policy.

"I WAS talking to Sharples, the insurance agent, the other day," Gus went on, "and he showed me that even a policy that covers you for one hundred thousand dollars for a single person injured in an accident or up to three hundred thousand dollars for several people only costs about a third more than the five-thousand, ten-thousand protection.

"If you want to take a chance on going without fire and theft protection on your car, that's not so bad. If the car is stolen or burns up, you can't lose more than the value of the car."

"I'd like to see anyone swipe my car," Cardon bragged. "No theft insurance for me. Any crook that can solve the secret locks on this bus is welcome to take it."

Gus smiled. "There's something in that. Really locked cars aren't often swiped. By the way, how'd you get smashed this way?"

"One of those big five-ton trucks cut me off," replied Cardon. "Didn't do him any damage at all."

"That's lucky for you, else you'd have had to pay for fixing the truck, too," Gus commented. "Maybe next time you'll bust the rear end off one of those ten-thousand-dollar limousines, then you'll be in for it."

"Well, what of it?" Cardon growled. "You just said these insurance birds let you pay most of the bill before they ante up a few blue chips."

"Wrong again!" Gus grinned. "Property damage insurance isn't like collision insurance. There's no low limit on property damage. You're protected right down to a dime's worth of busted parts on the other fellow's car. Of course, ordinarily you aren't likely to do more than a thousand dollars worth of damage if you hit a car, because the majority of cars on the road today aren't worth much more than that. But there's other ways you can bust things.

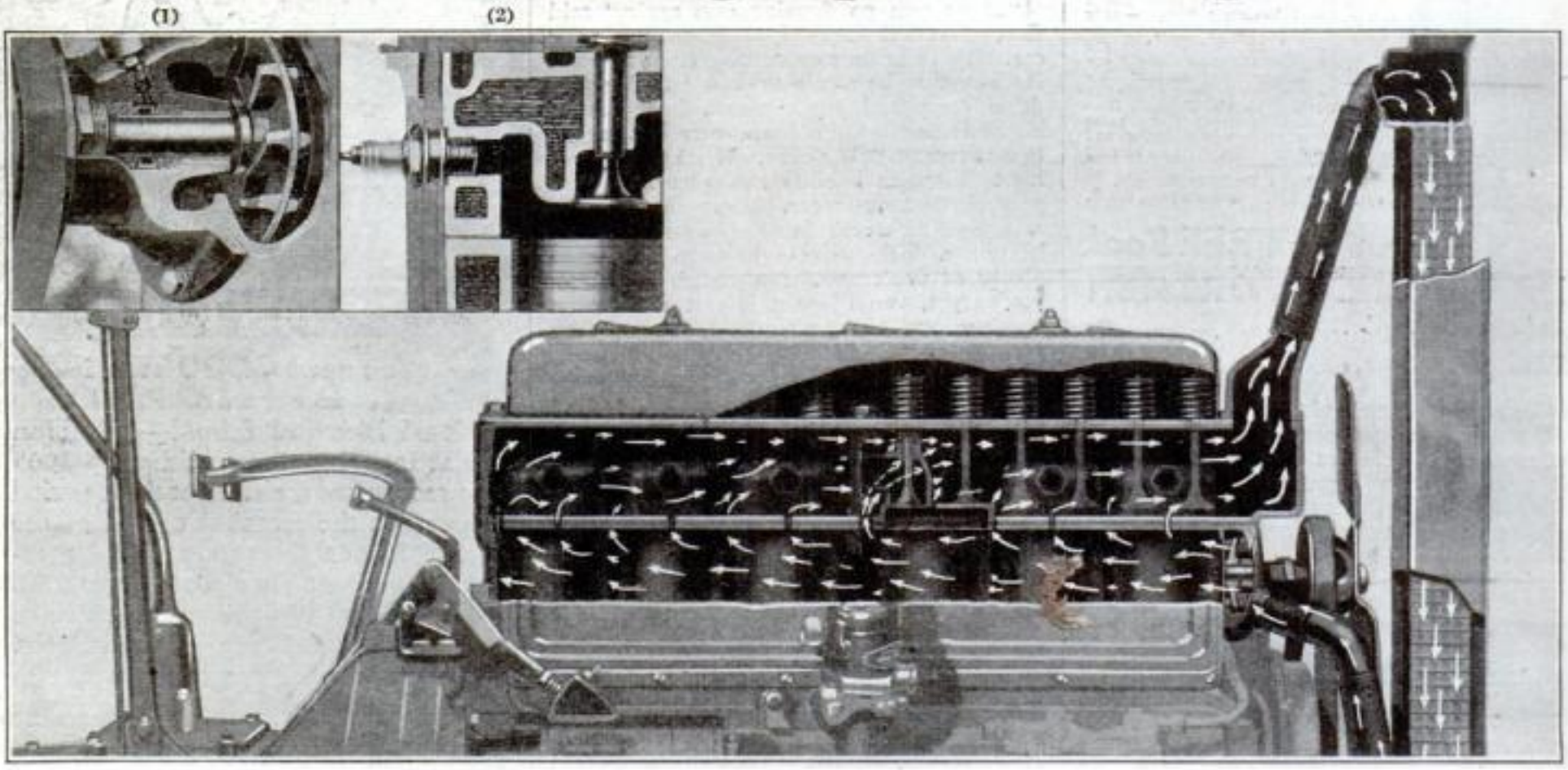
"FELLOW I know had something go wrong with his steering gear and the car swerved off the road, slewed across the sidewalk, crashed through a plate glass window, and knocked the stuffings out of a fancy automatic printing press that was running in the window. Cost this bird seventeen hundred dollars to square it, besides the hundred bucks he spent for a lawyer."

"If he'd been careful like I am," Cardon said, "he wouldn't have had his steering gear fall apart that way. Well, I guess I'll run down the street and do some errands while you're finishing the job—er—did I hear you say that one hundred thousand liability only cost a little more than ten thousand?"

"About a third, I think," Gus replied, winking slyly at Joe Clark, his partner.

"Joe," he observed, after Cardon had gone, "I'll bet you a dollar against a busted spark plug, that know-it-all comes back in an hour with the biggest policy they'll write!"

CHEVROLET'S COOLING SYSTEM
is designed for sustained high-speed driving



Main illustration shows how water circulates through the radiator and completely around each individual valve and cylinder of the Chevrolet engine. Inset illustrations above show (1) the design of the positive propeller-type Chevrolet water pump. (2) The construction of the Chevrolet cylinder head, assuring complete water circulation around each valve.

Drive a Chevrolet Six at top speed, hour after hour—in any kind of weather—and watch the heat-indicator on the dash. Notice how consistently the Chevrolet engine maintains the proper operating temperature.

The reason for this performance lies in Chevrolet's cooling system—skilfully designed, highly efficient, in keeping with the latest principles of fine-car design.

The Chevrolet radiator is of the cellular core type, Harrison hexagon design—with a maximum of cooling surface. It holds an exceptionally large amount of water, the total capacity being 11½ quarts.

The design of the cylinder block is unusual for a car of Chevrolet's low price. This block is so constructed that each one of the six cylinders and each one of the twelve valves is completely surrounded by water. This helps to keep the cylinders and valves from warping, and assures high operating efficiency at every speed.

Chevrolet has a positive propeller-type water pump, instead of the suction-type used on several other low-priced cars. This pump drives a definite amount of water through the system at every speed—does not suck up steam at high speeds, as in the case of suction pumps. At a speed of 60 miles an hour, for instance, *a total of 25 gallons of water a minute* is driven around the cylinders and valves, and through the radiator to keep the motor at efficient operating temperature.

But this cooling system is only *one* example of Chevrolet's advanced design. There are dozens more that every reader of Popular Science Monthly is sure to appreciate—the crankshaft, the pistons, the fuel and carburetion systems, the weatherproof brakes, the banjo-type axle, and the wood-and-steel Fisher body.

Investigate the Chevrolet Six at your very first opportunity. You'll find a great deal to interest you—a great deal to admire—in this soundly-built low-priced car.

Chevrolet prices range from $475 to $650, f. o. b. Flint, Michigan. Special equipment extra. Chevrolet Motor Company, Detroit, Michigan

NEW CHEVROLET SIX
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Then, ready with the razor, and you'll find it keen to go. Quickly your beard vanishes as the blade glides along. And that smooth, smiling face in the mirror is yours!

Now for the happy ending to this perfect shave—Williams Aqua Velva. Dash it over your face. Its pleasant tingle wakes up the sleepy tissues, helps to firm them. Aqua Velva tones the skin. Helps to care for the unseen nicks and cuts. Holds the natural, good complexion moisture and keeps the face as fit as Williams lather leaves it.

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